THE

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EXPERIMENTAL ENGINES.

THAT a 700 dollar engine is good enough for a technical school is evidently not the opinion of Prof. Weighton, of the Durham Science College of Newcastle, for he has now got to play with a quadruple expansion engine of very elastic design, it having, to begin with, movable cylinder liners, in order that the cylinder ratios may be varied. The cylinders are as follows, the diameters given being those with and without the movable liners:—

No. 1, 7 inches and 8½ inches	Stroke 18 inches.
No. 2, 10½ inches and 12 inches	
No. 3, 14 inches, 15½ inches, and 16½ inches	
No. 4, 23 inches	

In other respects the engine is of the plain slide valve link motion type. Clearly, however, it can be worked in many cylinder ratios; as quadruples in two ratios, as between No. 1 and No. 3, with other 10 variations upon the intermediate sizes, as triples in six ratios, with 10 other intermediate variations, and as doubles with seven ratios; but we believe that every ratio possible is not arranged for, or, at least, is not given in the Professor's paper, descriptive of the engine, read before the North-East Coast Institute of Engineers. Then the engine can be worked as so many singles and at pressures up to 210 lbs., except upon the 23-inch cylinder as a single. The cut-off is variable between 3 and 14 inches; this latter the main valve cut-off. The intermediate receivers may be varied in capacity by opening or closing a valve. Jackets are provided to barrels and to covers at both ends, and steam of any pressure is admitted at will to any of them.

The cranks can be set to any of eight equiangular positions relative to each other. Condensing is either by jet or surface, and the engines may be either worked expansively by the link, or throttled. The receivers and jackets have each separate drain taps for independent measurement of the condensed steam. The valves are flat slides, with Meyer back slide variable cut-off plates. Pistons are plain Ramsbottom cast-iron.

The dynamometer is of the Froude hydraulic type, with a spring controlled lever arm and a pencil to record on a moving band.

A constant stream flows through the dynamometer to keep its temperature down to a reasonable degree. Of course, as the whole of the work goes off as heat in this dynamometer water, the rise in temperature might be utilised as a measure of the brake horse-power, but we do not see any reference to this which would co-relate in an interesting manner with the arm pressure reading and the indicated horse-power.

Every facility for measuring water discharge temperatures is provided, and the tests being made by Prof. Weighton are intended to show as clearly as possible the effect of various different conditions. It is his object to vary *one* factor at a time, instead of obscuring results by the change of several factors, which is so likely to produce figures that cannot be credited with any degree of accuracy to the proper source.

C

Prof. Weighton has divided the tests he has already made into two groups, of which one was carried out with a view to finding out how the behaviour of the engine was dependent upon the number of expansions employed.

The other set was made to ascertain the relative advantage of throttling and expansion. In all the trials the speed and boiler pressure were maintained respectively at 140 and 210, and the results were only doctored to the extent of a correction for vacuum, which was called standard at 26 inches. The best result obtained, namely, 12·63 lbs., of water per H.P. hour, was with 17·4 expansions. As the boiler pressure was 225 lbs. absolute, or nearly so, the terminal pressure would be approximately 13 lbs. had the steam been a perfect gas isothermally expanded. As something of its bulk would disappear in ordinary working, this best result is not far removed from the good practical rule that the terminal pressure shall be a half atmosphere. By quadrupling the above ratio of expansion, the water per H.P. hour was increased to 14·6 lbs. This merely emphasises the folly of undue expansion, and shows how wasteful it is to carry expansion to extreme limits. By such an increase, as pointed out, the power of the engine would be practically reduced to one-third. This experimental engine is, of course, but small, and it may be because of this that, though working with steam at 210 lbs., its performance is not particularly good, for considerably less than 12·6 lbs. of steam per H.P. hour has before now been found to be sufficient with triple expansion engines.

But it is very easy to pile cylinder upon cylinder without adequate result. Too many cylinders implies too many pistons and valves to be dragged to and fro, and so much extra surface from which to radiate heat, and generally we are much inclined to think that the principle of compound working has been carried a little too far, just as expansion had been until it became recognised that throttling possessed virtues unsuspected when it came to be seriously tested, and to just how far expansion could be economically carried. In these engines there should be found an implement for careful work of investigation upon superheat and jackets. They are not severely complicated, and are of usual build. They must always possess certain disadvantages, in that they are not actually practical engines. All the same, they should be very useful for determining the influence of each factor that is capable of being varied in the *régime* of the engine. But our technical professors, with their engines, are becoming something like the scientific vivisectors who, having for the sake of science fully observed the funny behaviour of a flayed dog when dusted with red pepper, continue to repeat the experiment indefinitely without gathering any results other than the originally observed grotesqueness. Engine tests are getting as common as blackberries. How thankful they should be they have no feelings.

THE PACIFIC CABLE.

The *Journal* of the Society of Arts of last Friday contains the report of a paper read before the Foreign and Colonial Section of that Society on "The Progress of the British Colonial Empire during the Sixty Years of Her Majesty's Reign." The Society of Arts was fortunate in selecting the the Right Hon. Sir Charles Dilke for the inaugural address of the session, as the author of "Greater Britain" is well qualified to deal with the subject. The address is an interesting one from a general point of view, and to those connected with telegraphy, it has a special interest, when its result shows that two prominent statesmen, opponents in politics, like Sir Charles Dilke and the Earl of Jersey, agree in the necessity of strengthening the telegraphic bonds which tie the Mother Country and the Colonies together. Sir Charles Dilke, in closing the discussion which followed his address, said: "With regard to cable communication which was mentioned by Lord Jersey, I attach the utmost importance to its being British communication in British hands through all parts of the Empire, especially along the Cape route. Undoubtedly in time of war the great bulk of trade would have to be on that line to the East, and at the present moment we had not even telegraphic communication of our own to Gibraltar, to Malta, or to Sierra Leone, nor even is the Cape better placed. All the lines touched on Portuguese, French, or other foreign territory." This statement is quite unanswerable. As we have often pointed out—and we again repeat—the Cape, India, and Australasia are absolutely at the mercy of our possible antagonists so far as telegraphic communication is concerned. This should be mended, and can be mended, by a trans-Pacific cable from Canada to Australasia, with an extension in due course to the Cape of Good Hope, and later, from the latter colony to England, *viâ* St. Helena, Ascension, Sierra Leone, and, for want of a better point, Gibra'tar.

In an Imperial cable route Gibraltar would be a weak link. Any ordinary fisherman could cut any cable going into Gibraltar in half an hour, as cables through the Straits must lie on the shallow banks on the north or south sides. In many places the cables now lying there are visible to the occupants of fishing boats when the sea is calm. It appears to us, therefore, that Gibraltar must be left to look after itself, and that the Imperial line should be laid direct from Sierra Leone to some point on the west coast of Ireland, where the water is less favourable to grappling operations than the neighbourhood of Brest and Cherbourg.

In these days, when telegraphy has become a necessity of administration, and, indeed, of life, it seems to be trifling with the nation's resources to spend money in fortifying, in an inadequate way, some petty coaling station, while the Imperial lines of communication are in such a perilous state.

Possible Evaporation.

A recent note in the *Engineering Record* discusses the question of possible evaporation in a steam boiler. If the total heat of combustion of a fuel be known, and the percentage efficiency of the boiler, the evaporation possible is known at once by a simple calculation. There are semi-bituminous coals which will give 15,400 thermal units, and if burned in a boiler with 80 per cent. efficiency, they would give an evaporation of 12·75 lbs., a figure that may well be assumed as possible, for there are recorded efficiencies greater than 80 per cent. Why does efficiency fall below 100 per cent.? In the first place, there is a radiation loss of 3 to 4 per cent. which may sometimes be even less than this. Then in hydrogenous coals or moist coals there is the heat absorption due to steam formation, and this may be as high as 10 per cent. where the flue gas leaves at 400° above the external atmosphere. Unburned gas may give 2 to 4 per cent. of loss, and there are losses due to surplus air. An increase of 2 per cent. in efficiencies means a further evaporation of one-third of a lb. of water. If, then, we start from a datum of 12·75 lbs., it is not unreasonable to expect as much as 13 lbs., or even a trifle more, as the output of a particularly favourable coincidence of conditions. Such cases must, of course, be extremely rare, and as a rule could only be secured by adjusting the demand for steam to the best working conditions of the furnaces.

WELDED RAIL JOINTS.

There is certainly no part of the road-bed of steam railroads that has received more careful attention of late years than the rail joints. Time was, says the *Scientific American*, when these were the most neglected portion of the track, and two small strips of iron, loosely bolted to the web of the rail, were considered to be a sufficient reinforcement. So long as the ends of the rail were held fairly well in line, the roadmaster was satisfied. The idea of attempting to restore the whole strength of the rail does not seem to have been seriously entertained, and as a consequence the rail ends soon became permanently bent under the incessant pounding of the traffic, and every joint became a hollow spot, lying more or less below the track level. To-day, however, the engineer has changed all that. By designing the joints on scientific principles, giving them a section adapted to the strains which they have to endure, it has been possible to produce a length of track whose vertical stiffness and strength are continuous, the joints displaying these qualities as fully as the body of the rail itself.

Such, at least, is the condition of first-class modern track when it is first laid. Laboratory tests have shown that some of the modern joints possess even greater rigidity than the rail itself, at least under the conditions of test where the load is applied as a static pressure, and has no dynamic effect. Conditions of service, however, are so entirely different that it can easily be understood that the results fall far below those which are obtained in the testing machine. The loads, represented by the weight of the train concentrated on the wheels, come upon the joints with the dynamic effect of a blow, the bending effect of which is far greater than would be due to the quiet load. The tendency of this pounding is to loosen the fastenings and allow movement and wear of the parts, with the ultimate result that no amount of screwing up will take out the "sag," and keep the joint up to level. Although it is true that by increasing the weight of rails and fastenings these difficulties are reduced, yet in the best of track the joints still remain the chief source of care and expense.

In view of this fact it is natural that engineers should be directing their energies to the design of a continuous joint, in which there shall be no break in the metal. Such a joint would at once get rid of the defects of all "fished" or spliced joints—always provided, of course, that the welded joint shall be perfectly sound.

Of late years the production of better rail joints has been greatly stimulated by the rapid development of electric traction, and this for two reasons: First, the destruction of joints was increased by the heavy pounding of rigidly supported motors (a difficulty which the partial supporting of the motors on springs has merely reduced, but has not removed); and secondly, the desire to secure the greatest possible electrical conductivity has directed attention to welded joints.

The first efforts to secure a continuous metallic joint were made by electrical welding, and this was followed by what is known as cast welding. In the first case a powerful electric current is passed through the ends of the rails and pieces of iron, known as chucks, which take the place of the fishplates. When the metal has been raised to a welding heat, heavy pressure is brought against the side plates and they are welded to the rails, the flow of metal filling in the space between the rail ends and forming a butt weld. It is claimed, and justly so, that a perfectly welded joint is stronger than the body of the rail. In cast welding, molten cast iron is run into a mould which incloses the abutting rail ends, which are thereby heated (or are supposed to be) to the welding point, so that the resulting joint is solid and continuous.

Mr. W. K. Bowen, superintendent of the Chicago City Road, has recently given some data in a paper before the convention of the American Street Railway Association, at St. Louis, which promise well for this style of joint. He stated that, of the 17,000 cast welded joints made on his road in 1895, only 154 were lost, and these breakages were due to flaws in the metal. Comparative tests have shown the joint to be "far stronger than the rail itself." The joints are made as follows: After the rail ends have been scraped or filed off so as to present a bright surface, a cast iron mould is placed around the joint, the fit being made so snug as to prevent the escape of any metal from the mould.

The metal is then poured in, and the outer part of the casting being chilled by the mould, sets first, forming a crust which retains the molten metal. As this crust contracts faster than the interior, the latter is forced up against the rails and a more perfect contact is ensured.

Although the first object of electrical engineers in making welded joints, electrical or cast, was to secure better electrical conductivity, as a matter of fact the mechanical advantages of this style of joint are of scarcely less importance. The strength of a bolted joint is entirely dependent on its fastenings being tightly held in place; and the construction of city tracks is such that these fastenings are often beyond the reach of the trackman's wrench. However well they may be secured when the track is laid, they soon slack up under the pounding of the traffic. This fact will account for the noisiness of street as compared with main line track. The welded joint requires no attention and may be covered up by the street paving with impunity.

As to the question of expansion and contraction of the rails due to change of temperature, it was proved in an experimental test at Johnstown, a few years ago, and in subsequent tests, that the elasticity of the steel is capable of accommodating changes of length as take place. It should be noted in conclusion, however, that a continuously welded track, to be safe from distortion, must be exceptionally well spiked to the ties, and the ties and ballast must be of first class quality.

THE ILLUSTRATION OF PHASE DIFFERENCES.

It is often a matter of great difficulty to teachers of electricity to convey an adequate explanation of many points in alternating current problems; and greater difficulty is experienced with alternating currents than with direct currents, chiefly on account of the lack of apparatus, adapted to lecture purposes, with which to illustrate the points of difficulty as they arise.

The student who, being acquainted with the laws of continuous currents, is just beginning the more complicated subject of alternating currents, only too frequently fails to digest the meaning and significance of phase difference between current and E.M.F. The difficulty is probably enhanced since difference of phase is usually explained by inference and not directly shown as a lecture experiment. It is, therefore, of importance to teachers of the subject to know that by means of a moderately simple piece of apparatus, the difference of phase between two currents or between current and E.M.F., can be shown as a lecture experiment.

In an article in *Technology Quarterly*, Mr. Louis Derr describes some apparatus which he has devised to show these phenomena.

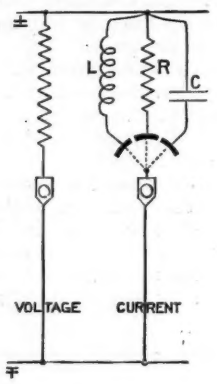
A powerful electro-magnet is mounted on an upright stone base, and a wire is stretched across the field between its poles. At the top of the apparatus the wire terminates in the free end of a light metallic hinge, to which a small mirror is cemented. An alternating current is sent through the wire, which is consequently urged alternately backwards and forwards. The vibrations of the wire may be observed by means of a beam of light, reflected from the mirror, the hinge preventing all lateral motion and twisting. The end of the wire away from the hinge carries a turning-pin and a device for adjusting the mirror. The turning-pin is turned until the period of free vibration of the wire is the same as that of the current. A second mirror capable of rotation about a vertical axis is placed in the path of the reflected beam which finally falls upon a screen. On turning the second mirror there is depicted on the screen a representation of the vibrations of the wire.

By using two such wires the difference of phase between two currents, or between current and E.M.F. can easily be shown. The mirrors attached to the wires are first adjusted until the spots of light on the screen are coincident, and the currents whose phase relationships are to be examined are passed through the wires. The spots of light on the screen then became coincident lines of light, and on rotating the

revolving mirror any phase difference between the two currents at once becomes apparent.

To observe phase relationships between current and E.M.F., one wire is connected to the terminals of the given circuit through a suitable non-inductive resistance, whilst the other wire carries the current to be studied.

The phase relationships between E.M.F. and current, according to the nature of the circuit, can be shown by means of a multiple-way switch as indicated in the accompanying figure, which is taken from Mr. Derr's paper. In the figure, L, is an inductive resistance; R, a non-inductive resistance, and C, is a condenser.



The effects of any desired combination of self-induction and capacity can be shown in a similar manner.

The apparatus is admirably adapted to lecture purposes, but is apparently unsuited for accurate quantitative measurements.

THE CALIBRATION OF A BRIDGE WIRE.*

By W. M. STINE.

Of late, interest in this subject seems to have been revived, and several new methods and modifications have been proposed. That there is need of development no one familiar with the academic methods prescribed by several works on measurements will have a doubt. The original method of Prof. Carey Foster, in which a "gauge" of low resistance was employed, is both tedious and intricate, and those who have followed him have rather increased the complexity.

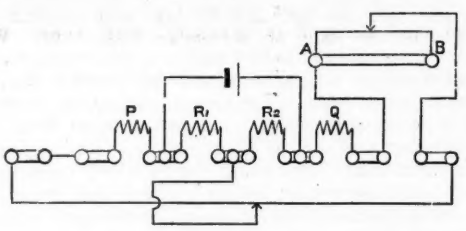
To be sure, in modern methods of electrical measurements there is a lessened necessity for the calibration of bridge wires, and this has been further emphasised by improved methods of wire manufacture, producing wires so fairly uniform that it is only in the most accurate work that they need be calibrated. But the necessity for calibration occasionally arises, and it is convenient to have a rapid and accurate method for the process.

The method given below was devised by the writer several years since. The aim was to present to his students a simple, direct and accurate method.

Since calibrated bridge wires are mostly necessary in connection with the Carey-Foster apparatus for comparing resistances, the method was based upon this process.

The Auxiliary Wire Method.—It is necessary to know two properties of the wire—the space rate of change of its resistance or calibration, and the resistance of unit length, commonly denoted by the symbol ρ. Both these factors may be simultaneously determined.

The wire under test is connected to a suitable commutator, and in a gap on one side of the bridge circuit an auxiliary wire is inserted. This auxiliary wire may be an ordinary slide wire, or a special device. In its selection, for convenience, it may be nearly similar to the wire under test. The special device is readily constructed. Two double binding posts are attached to the ends of a board, the posts being placed about one-half metre apart. A suitable slide, making a spring contact with the wire, is moved along a groove cut in the board parallel with the wire. All connections should be of low resistance. The connections are shown diagrammatically in the fig.



Here P is a standard ohm whose value is accurately known; Q is a nearly equal resistance, preferably a 1 ohm coil whose value is known to be less than P. R_1 and R_2 are the usual ratio coils, while A, B is the auxiliary wire.

The first step is to make Q = P.

This is done by placing a piece of copper wire in series with Q, and adjusting its length until equality of resistance is obtained. This equality is determined, when upon reversal

$$X_1 - X_2 = 0$$

the quantities, X_1 and X_2, being the scale readings. This relation follows directly from the general equation of the Carey-Foster method.

$$P - Q = (X_1 - X_2)\,\rho.$$

One of the standards, P and Q, preferably P, is now shunted by a resistance box. The particular value to be given the shunt is determined by trial. The element determining this is the desired length of wire for the first calibration. Suppose this to be 10 centimetres. The sliding contact is placed on the desired point and the balance obtained by charging the resistance of the shunt. The resistance of this section of wire is then calculated from the resistance of P and the shunt.

To proceed, the commutator is now reversed and the balance obtained by moving the contact of the auxiliary wire. The contact to the wire under test is then moved along to a second point 10 centimetres from the first, the commutator reversed and the balance again obtained by adjusting the shunt. This process is repeated until one-half the wire is calibrated. The other half of the wire is then calibrated by the same method. The values for P can be directly obtained from the calibration.

Another interpretation is sometimes given to calibration—the division of the wire into spaces of equal resistance. This is accomplished in much the same way, by using the first value of the shunt throughout the succeeding tests.

* New York *Electrical World*.

TESTS OF 200-KILOWATT CONTINUOUS CURRENT PARSONS TURBO-GENERATOR.

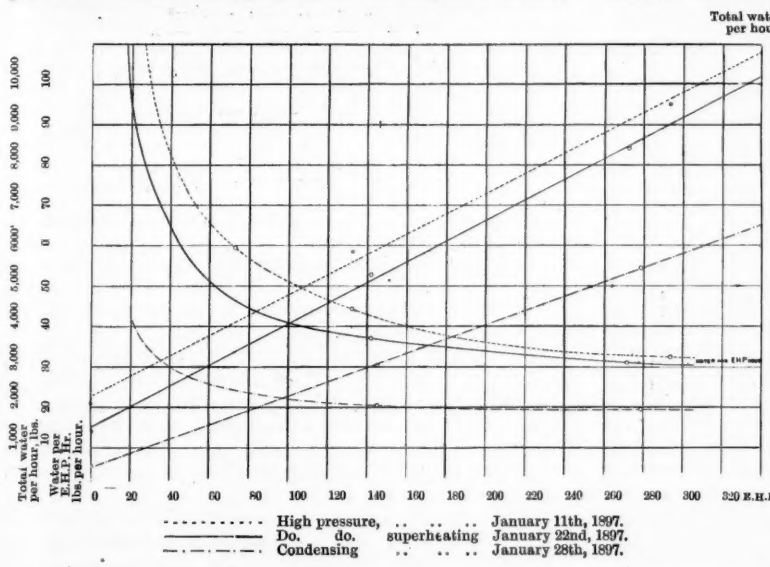
By W. D. HUNTER, M.I.E.E.

On the 11th, 22nd, and 28th of last month, a series of tests was carried out on a 200-kilowatt continuous current Parsons generator, for the purpose of determining the steam consumption under different conditions of service and various grades of output.

The generator was designed to work with a fair all-round economy, whether exhausting into the atmosphere or a condenser, although, in general, the latter method is expected to be employed.

The difficulty of obtaining high economy imposed by such a set of conditions can only be partially met in ordinary engineering practice by adding to the engine a costly automatic expansion gear, which cannot always be relied upon when required to act within a widely-fluctuating range of load, or when called upon suddenly to work *at full power* either high pressure or condensing. In the case of the Parsons turbo-generator, the provision for expansion is constant, and when designed to exhaust into a condenser only,

the terminal pressure would be about 1½ lb. to the square inch, with an initial boiler pressure of 140 lbs., the steam being thereby expanded about 100 times. The degree of economy obtained under these conditions is already well known, the last 150-kw. generator supplied to the Newcastle and District Electric Lighting Company requiring only 17·28 lbs. of water per E.H.P. per hour at full load, as given in our issue of November 13th, 1896. When, however, the motor is required to give full power, working either high pressure or condensing (with a moderate consumption of steam), the problem of how to meet conflicting requirements presents many difficulties, and the fact that these difficulties have been successfully met in the design of the generator tested, without any addition being made to the cost or parts of the machine, is further testimony to the adaptability of the steam turbine for every condition of service. The particular machine tested had one of the parallel flow type of turbines coupled direct to a continuous current dynamo, designed for a normal output of 200 kilowatts. Steam was admitted at one end of the cylinder, the admission being controlled by an exceedingly sensitive and effective electrical governor, which reduced or prolonged the period of admission without in any way altering the initial pressure at the steam chest of the motor; there was therefore a complete absence of throttling with the attendant disadvantages, which would be felt when working on a fluctuating load. The action of the governor left nothing to be desired,


Total water per hour.
Total water per hour. lbs.
Water per E.H.P. Hr. lbs. per hour.
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 E.H.P.
High pressure, ... January 11th, 1897.
Do. do. superheating January 22nd, 1897.
Condensing .. .. .. January 28th, 1897.

the rise in voltage being only momentary when the whole load of nearly 280 electrical horse-power was thrown off. Between full load and no load the generator responded to whatever

Tests of 200-Unit Turbo Dynamo.

Kilowatts.	Total water per hour. lbs.	Water per kw. lbs. per hour.	Water per E.H.P. lbs. per hour.	
219·2	9,466	43·20	32·22	Non-condensing.
98·7	5,848	59·23	44·18	
54·5	4,330	79·50	59·30	
0	2,092	...	...	
203·0	8,429	41·52	30·97	Non-condensing and superheating 30° F.
106·1	5,287	49·83	37·17	
0	1,402	...	...	
208·0	5,443	26·16	19·51	Condensing, but no superheating. Vacuum at full load 25".
108·4	3,037	28·02	20·90	
0	531	...	...	

calls were made upon it without any hunting, this valuable property eminently fitting it for electric traction or haulage purposes.

During the trials measurements of electrical output, steam pressure, vacuum, &c., were taken each time the water from measuring tanks was used up, the intervals at full load being about eight minutes. The measuring tanks from which the feed water was drawn were carefully calibrated, and the electrical output was taken by a Kelvin wattmeter, the readings of which were checked by ammeters and voltmeters. The figures obtained during the trials are shown in the table.

It will be noted that for the full power trials the water used per electrical horse-power hour when, exhausting into the atmosphere, was 32·22 lbs. Under similar conditions, but with the steam superheated 30° Fah., the consumption was 30·97 lbs. With saturated steam, and exhausting into a condenser (vacuum 25 inches), the consumption fell to 19·51 lbs. per E.H.P.-hour.

The generator ran throughout the trials smoothly and without a hitch, the automatic lubricating arrangements acting perfectly.

DECIMO-METRO VOLAPÜK.

Her Majesty's Government has under consideration the facilitating of the use of the metric and decimal systems, by the introduction of an enabling Bill in Parliament. It is to be hoped that the Bill will deal as completely as may be possible with the question. Since our early youth we have experienced what every Englishman must have experienced, namely, the unwieldiness of our present alphabet, and the great want of uniformity in the alphabets in use in different countries. The alphabet of Great Britain and the Colonies consists of some twenty-six characters, a widely different number from that in use in China. The characters employed in different countries are very unlike. The significations conveyed to the human mind by the assemblages of such characters as may resemble each other are not similar even in European countries. In fact, the only language common to different countries is the language of figures and mathematical symbols. To get over this difficulty, would it not be advisable that the number of letters in the alphabet should be reduced to 10, or increased to 100, so that one standard can be initiated, with the hope that other countries will follow our lead, and a rational alphabet be established throughout the world. The many advantages of this system will strike the reader. Standard letters or characters could be adopted. These characters could be deposited at Greenwich Observatory, and their weights in grammes and dimensions in metres could be duly recorded, so that they might be reproduced at any time should the standards be lost or damaged. Amongst other uses it would be very convenient in households to know that a letter for one of our colonies, say Australia, would be carried to destination if its weight did not exceed that of the standard character, A, of one-hundredth of a metre high, by two-thousandths of a metre wide, and one-thousandth of a metre deep. Cloth, sugar, &c., could also be measured and weighed, should the necessity arise, by our standard letters. In fact, these letters would duplicate our new decimal and metric system of weights and measures, while serving their own purposes.

The standard I could be made to weigh five-tenths of the standard A, and other letters could be similarly dealt with. J would naturally be the omega of the new alphabet, but it would be better to adopt O. In this case the tenth letter, being the beginning of the second series, would be written A O. The K of the present alphabet would be represented by A A, and so on, in decimal notation. To carry this matter one step further, the present alphabet might be suppressed, and the numerals at present in use be adopted. By this latter proposal, children would have only one alphabet to learn, namely, the alphabet of numerals, and this alphabet could be used either for calculation or writings.

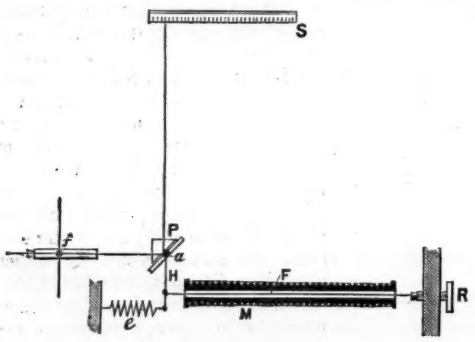
If, in addition to these advantages, words were limited in

length to 10-characters, sentences to 10-words, paragraphs to 10 sentences, and articles or speeches to 10 paragraphs, the millennium would be at hand.

If the President of the Board of Trade would add another brilliant to Queen Victoria's crown, he should recommend Parliament to incorporate in the Bill on decimal and metrical mediums of exchange, a decimal and metrical alphabet on the C.G.S. principle.

A NEW FREQUENCY INDICATOR.

G. W. Meyer has invented an ingenious and simple instrument for indicating the frequency of oscillating currents, depending on the fact that the heat generated in a wire magnetised by these currents is proportional to their frequency. This instrument* is illustrated in fig. 1. A thin steel wire, F, lies in the magnetic field of a solenoid, M, traversed by the alternating current. It is thereby subjected to a cyclic mag-



netisation which heats the wire by the amount of energy wasted by hysteresis. The expansion of the wire imparts movement to the lever, H, which turns on a fulcrum, *a*, the other end of the wire being fixed to an adjusting screw, R. The wire, F, is kept stretched by a spiral spring, *e*, connected to the free end of the lever, H. A reflecting prism, P, is attached to the lever near the fulcrum, *a*. A scale, S, is fixed at a convenient distance above the prism, and a telescope, *f*, is placed in a position to receive the reflected image of the scale from the prism. The reading is taken from the scale by means of the crossed wires in the telescope. The reading indicates the extension of the wire, F, which is measured by the angle through which the prism, P, has turned. The temperature of the wire and the heat generated by hysteresis can, of course, be estimated from the reading of the scale.

If a is the linear coefficient of expansion.

L_0 the length of the wire before the experiment.

L_t the length of the wire when heated.

t the rise of temperature.

then
$$L_t = L_0 (1 + a\,t)$$
$$t = \frac{L_t - L_0}{L_0\,a}.$$

It is assumed that there is no perceptible change in the temperature of the room during the experiment; which is usually the case. Before each experiment the instrument must be set to the zero of the scale.

In order to estimate the frequency of the current from the temperature, the value of the integral
$$\int H\,d\,J$$
for the kind of steel of which the wire is made, and its volume and weight, must be known. These factors are introduced as constants into the calculation.

A thin steel wire is to be preferred to a thick one, because it consumes less energy, and follows quickly the variations of the frequency of the current in consequence of the very small heat capacity of the wire. Eddy currents are also very much reduced in very thin wires. This is of considerable importance, since it very much simplifies the equation for the instrument. Viscous hysteresis may also be neglected in very thin wires. By using a very thin wire, there is the further advantage that the wire is heated and cooled almost instantaneously.

As an example of the practical application of these principles, the following calculation of the dimensions of the instrument illustrated in fig. 1 is given:—

The steel wire, F, subjected to hysteresis, has a thickness of 0·4 mm. and a length of 80 cm. Its volume therefore amounts to
$$0{\cdot}02^2 \times 3{\cdot}1416 \times 80 = 0{\cdot}1005312 \text{ cm.}^3$$

The energy consumed in a single cycle, if the wire is made of Wolfram steel, is, according to Hopkinson, 216,000 ergs per cm^3.

In this special case, therefore, the energy consumed in one cycle is
$$v = \frac{0{\cdot}1005312 \times 216{,}000}{7{\cdot}7}$$
$$= 2{,}820 \text{ ergs.}$$

An erg raises the temperature of a cm.^{3} of iron by
$$2{\cdot}81 \times 10^{-8}\ ^\circ\text{C.}$$

The rise of temperature of the wire, which is produced by 2,820 ergs., will, therefore, amount in one magnetic cycle to
$$\frac{2{,}820 \times 2{\cdot}81 \times 10^{-8}}{0{\cdot}1005312}\ ^\circ\text{C.}$$

Let N be the number of magnetic cycles in a second; then to find the rise of temperature of the wire in that time, we have to multiply the above value by N.
$$t = \frac{2{,}820 \times 2{\cdot}81 \times 10^{-8}}{0{\cdot}1005312}\,\text{N.}$$

If the number of magnetic cycles per second is 10,000, the rise of temperature will be
$$t = 78{\cdot}85\ ^\circ\text{C.}$$

The value
$$\frac{2{,}820 \times 2{\cdot}81 \times 10^{-8}}{0{\cdot}1005312} = 0{\cdot}007885$$
is always a factor in the calculation, and may be called the constant of the instrument.

This method gives a simple way of determining the frequency of high frequency currents. To obtain the frequency of the current, all that is necessary is to multiply the number of magnetic cycles, N, by 2.

Soft-iron is unsuitable for use in this intrument, both because it requires to be of considerable thickness, and because the loss of energy by hysteresis increases considerably with a very short duration of the cycle. The temperature of the wire, in the above instrument, must not be allowed to rise above 300° C. since the permeability of the wire changes considerably above that temperature.

With very low frequencies, the effect of eddy currents will have to be taken into account. The instrument is best adapted for high frequencies. The instrument is also adapted for determining the form factor of alternating current curves.

Meyer has also devised a form of his frequency indicator, in which the magnetic circuit is entirely of iron or steel without any air gap as in the instrument described above.* An endless steel wire stretched over two pulleys is used for this purpose. The axis of one of the pulleys is mounted in fixed bearings, the bearings of the other pulley being on the terminals of a U-shaped piece, which is pulled down by a spiral spring. The steel wire loop is thus kept under tension. The fact that the magnetic circuit is steel throughout enables greater induction, and consequently greater hysteresis heat to be generated by the same ampere-turns.

Meyer has also suggested† that the generation of heat by cyclic magnetisation should be utilised for electrical heating, cooking, and such like. A steel vessel is placed inside the solenoid traversed by the alternating currents. In this vessel the liquid to be heated is placed. It has one advantage over electrical heating by resistance, that the source of heat does not require to be separated by insulating material from the substance heated. This would get over one of the greatest practical difficulties in electrical cooking apparatus. The hysteresis heating is very economical and very easily applied. If the substances heated are such as would exercise a corrosive action on the steel vessel, it can he lined electrolytically with copper or any more suitable metal.

* *Elektrotechnische Zeitschrift*, xviii., p. 47.

* *Zeitschrift f. Electrotechnik*, xv., p. 49.
† *Id.*, xiv., p. 523.

ELECTRIC TRACTION IN CHICAGO.

It seems to be the constant effort of a few persons greatly interested in competing traction systems to belittle the progress and development of electric tramways on the overhead wire method, and the undoubted increase in these lines throughout the United States is put down to the companies being forced to throw good money after bad, whilst it is also declared that they don't at any rate pay dividends!

It is not our business here to criticise American methods of finance, or to explain the reasons for capital stock being so enormously watered as appears to be the rule across the Atlantic; but we can give some facts of an instructive nature, gathered from the latest official reports of the Chicago electric lines, and therefore of the leading lines in America.

It is extremely interesting to note the changes that have taken place during the past three years in regard to respective mileage, cost, &c., of the different traction systems, and we append a brief table embodying these particulars, gathered first from the Chicago City Railway Company.

	1894.	1895.	1896.
Cable mileage open	34·47	34·77	34·92
Electric mileage open ...	74·22	117·81	141·76
Horse mileage open	52·63	9·79	4·09
Total income in millions of dollars	4·264	4·476	4·803
Total expenses in millions of dollars	3·946	3·015	3·185
Surplus after paying 10 per cent. on ordinary stock: in millions of dollars ...	·138	·321	·152
Passengers carried: millions—			
Cable	54·69	53·35	46·43
Horse	20·58	6·91	2·87
Electric	9·51	28·52	45·92
Miles run: millions—			
Cable	15·23	14·87	13·9
Horse	3·96	1·54	·62
Electric	1·85	5·52	10·01
Cost per car mile: cents—			
Cable	9·97	10·24	10·54
Horse	25·39	30·55	25·88
Electric	16·90	14·77	13·46

These figures are instructive enough for anyone to read, and they hardly require comment. It is clear that the change from horse to electric has enormously increased the receipts and net earnings, the working expenses being correspondingly reduced.

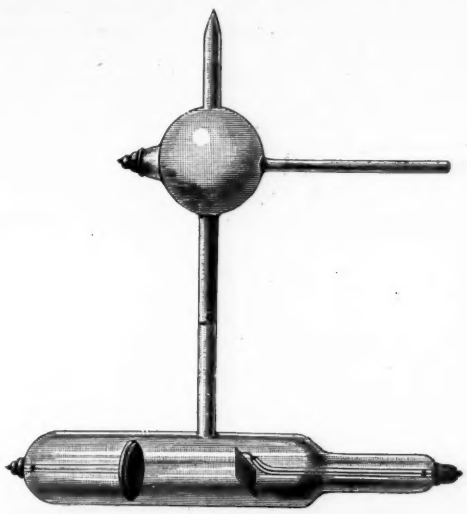
The West Chicago Street Railroad Company has suffered somewhat from the effect of changing its methods, also from bad trade, but is able to pay a 6 per cent. dividend for 1896 on its ordinary stock. Income from cable and horse lines both show a heavy decrease, whilst the electric lines have a corresponding increase. The cost per car mile on the cable sections is stated to be 13·88 cents; for horse lines, 20·77 cents; and for the electric roads, 10·69 cents.

The North Chicago Street Railroad Company pays for 1896 11 per cent. on its ordinary stock; it carried 56 million passengers, and made a total mileage of 10½ millions. The cost per car mile is given as 13 cents for cable, 12·5 cents for electric, and 22 cents for horse lines. Percentages of operating expenses to gross receipts are respectively 47·13 for cable, 51·23 for electric, and 90·98 for horse.

The tendency in the United States can at this rate hardly be considered to make for extensions in cable working, still less in horse traction.

A NEW RÖNTGEN LAMP.

Siemens & Halske have recently produced a new lamp for the production of Röntgen rays, in which the vacuum can be easily regulated to produce the maximum effect. The air pressure is reduced by taking advantage of the circumstance that when air, rendered luminous by the passage of electricity comes in contact with the vapours of phosphorous, iodine, or similar substances, it forms solid bodies; the vacuum is reduced by warming the bulb in the well-known way. From the illustration it may be seen that a supplementary bulb is joined on to a cylindrical focus tube by a glass connecting tube. In the bulb is an additional anode, and opposite this anode is a small adjutage tube whose walls are covered with the air absorbing material, for example, phosphorous. If when the lamp is excited and examined by a screen the fluorescence is weak, and the blue cone from the cathode shows that the vacuum is too low, the positive pole of the induction coil is connected to the auxiliary anode in the bulb and the discharge continued till the vacuum is sufficiently reduced. The special improvement in this lamp is evidently intended to provide the means of reducing the air pressure when it is too high, but all experience with



X ray tubes seems to demand rather some convenient means of increasing the air pressure, which is soon enough reduced by the cathode discharge in the ordinary working of the tube. Heating the tube may stave off the difficulty for a time, but after long use this device is useless and the tube has finally to be abandoned. The Siemens-Halske tube, however, appears to be very efficient while it works. With a 6-inch coil it is stated that it will show the skeleton of the hand through a brass plate 2 mm. thick.

THE ROYAL INSTITUTION AND SUBMARINE EARTHQUAKES.

Whilst expounding on "Recent Advances in Seismology" at the Royal Institution last Friday, Prof. John Milne, F.R.S., made much of the connection between earthquakes and the sudden interruption of submarine cables. Though laying stress on what is at times a very convenient explanation, it is extremely likely that Prof. Milne in no way exaggerated his case. He told us that such interruptions might especially be looked for off land with a steep slope, such as approaches the west coast of America, for instance.

There are cases, however, in other parts of the world where geological disturbance has been discovered after the cable has broken, so that it is clear we must be careful in sifting our evidence on this point.

A tidal wave was once made responsible for the breakage of a certain cable; indeed, this wave theory is annually recorded in an interesting calendar of telegraphic events. But it should be remembered that though this "tidal wave" was afterwards found to have made itself conspicuous on the same day that the cable broke, the latter also occurred a very short time after the original laying of the line, during which trouble was experienced, owing to the discovery, too late in the day, of an enormous bank.

In the above discourse, the fact of quite different soundings being obtained at different times on the same ground, was explained away in a pleasant manner by these various effects. Indeed, if Prof. Milne be correct, the telegraph engineer need no longer have any uneasiness (accompanied by sleepless nights) after he has laid a cable with insufficient slack, or after an insufficient survey, for its period of con-

tinuity will be—at any rate, in certain parts of the world—entirely at the mercy of the constancy or otherwise of the earth's crust under the "deep blue sea."

In venturing the opinion that Prof. Milne's lecture was one of the very best that has ever been delivered at the Royal Institution, we would fain back it up by the description "humorous, and at the same time instructive"—a combination admirably adapted to the palate of an Albemarle Street audience. Would it were more often indulged in, and successfully effected!

The maxim which we drew from the lecture for the special benefit of our readers was, that the engineer in charge of a cable expedition must be a bit of a seismologist—it is a long word, and takes some consideration to master its meaning—as well as a geologist.

We have before had occasion to observe that he should be a bit of a sailor. Perhaps the ideal proportions for the man in charge of such an expedition should be something like this:—Governor of men and disciplinarian, 75; engineer, 50; sailor and navigator, 35; electrician, 15; geologist and seismologist, 12. These proportional qualifications should be apart from the essential condition that he be a gentleman in the true sense of the word.

REVIEWS.

The Cyanide Process of Gold Extraction. By James Park. Champtaloup & Cooper, Auckland, N.Z.; George Robertson & Co., Melbourne; E. & F. N. Spon, London.

We do not hesitate to recommend "The Cyanide Process of Gold Extraction" to persons interested in the progress of the gold industry. Its author, who for a number of years has been manager of the Government experimental works and cyanide plant at the Thames School of Mines, had, as he says, the opportunity of treating many different classes of gold and silver ores, both simple and complex. We are not at all surprised to see that it is an authorised text-book for the New Zealand Government schools of mines.

A great deal has been said in the *Mineral Industry*, the *Engineering and Mining Journal*, the *Journal* of the Society of Chemical Industry, and in various technical papers, about the extraction of gold and the use of cyanide of potassium in the Transvaal. This book refers especially to Australia, and is a sort of compendium of all the knowledge required for scientifically working the cyanide of potassium process in a very simple and clear manner. It tells us the chemistry of the cyanide process, the cause of loss of cyanide, the action of cyanide on metallic sulphides, &c.

The chapter on laboratory experiments is extremely interesting. We also recommend the paragraph relating to the test of crude cyanide of potassium, and of the strength of cyanide of potassium solutions. The appliances for the extraction by cyanide of potassium, solution vats, leaching vats, filter frames, discharge doors, storage sumps, zinc extraction, are fully described and the approximate cost of plant of different capacities in New Zealand, when wood is used in the construction of the vats, is also given.

At Johannesburg, the cost of a cyanide plant is about 25s. per ton of tailings to be treated per month, which for 3,000 tons would amount to about £4,000; in New Zealand the cyanide installations are much cheaper, as shown by the following figures:—

For dry crushed ore—

Monthly capacity.			Cost.
350 tons	...	...	£750
700 „	...	...	950
1,050 „	...	...	1,200
1,400 „	...	...	1,500
1,700 „	...	...	1,800
2,000 „	...	...	2,000

For tailings—

Monthly capacity.			Cost.
1,400 tons	...	...	£1,200
2,800 „	...	...	2,000
4,200 „	...	...	3,000
5,600 „	...	...	4,000

The working of the cyanide of potassium process is the same in Australia as in Africa as regards the strength of solution, filling the vats, washing with water or alkaline washes if necessary, leaching with the strong 0·3 to 0·8 per cent. solution of cyanide, first washing with 0·1 to 0·25 per cent. cyanide solution from strong sump, second washing with 0·02 to 0·1 per cent. cyanide solution from weak sump, third and fourth washing with same solution, fifth washing with clean water.

It is generally assumed that the cyanide of potassium treatment is worked only in the Transvaal. This is a great mistake. Mr. James Park tells us that in Queensland, at Charters Towers, there is a plant treating 800 tons per month; at Croydon, the results have been most satisfactory. In New South Wales, at Mitchell's, the plant of the Australian Gold Recovery Company can treat 2,000 tons per month. In Victoria, the New Golden Mountain Gold Company have erected a plant which will treat 2,000 tons per month. The plant at Mount Torrens, in South Australia, belongs to the Government Customs for experimental purposes; and at the Virginia Company's cyanide works the sumps, built of cement, are 16 feet × 14 feet × 12 feet. In America, the cyanide process is at work in the States of Utah, Montana, Colorado, South Dakota, California, and also Mexico.

We should have desired more details about the zinc precipitation of gold compared with the electro-deposition of gold. These two last chapters do not give sufficient data on the advantages of the two methods. This must be attributed to the fact that no electrolytic installation exists in Australia.

Whatever may be the pretences of the partisans of the precipitation of gold by zinc, the drawbacks of this system are very serious; some reactions prevent the total precipitation of the gold, losses occur in collecting the metal from the zinc slimes, the bullion resulting from the zinc precipitation is worth 10s. less than the gold from electrolytic deposition, the consumption of zinc and cyanide of potassium is much greater in practice than it is indicated by the chemical equations; there is a waste of cyanide of potassium, owing to the formation of a double salt of zinc and cyanide of potassium, and also the oxidisation of a certain quantity of cyanide of potassium to cyanate. 1 lb. of zinc should precipitate about 6 lbs. of gold, the actual consumption is much larger, and amounts sometimes to 1 lb. of zinc per ounce of gold recovered. The gold from the electro-deposition is, on the contrary, quite pure, and its recovery does not cost so much.

Our Weights and Measures. By H. J. Chaney. London: Eyre and Spottiswoode. 1897.

At the present time, when the metrical system is apparently being advocated with more than ordinary zeal, this volume should be welcome. In it, we should think, everything is set down that can be known about standards of weight or measurement, their origin, history, and the methods by which they have been from time to time determined. There are many curious illustrations of both old and new standards of measurement, and of the interior of the Jewel Tower in Old Palace Yard, and of the Chapel of the Pyx in the east cloister of the Abbey of Westminster, which was once the Treasury of the land. The author deals largely with local measures also, but as far as regards the argument of the metrical men, that there is great labour involved in learning our English measures, this is effectually disposed of by a set of tables which, Mr. Chaney says, are all that need be taught. The number of items to be learned are practically the same as in the metrical system.

It is not merely with the British Isles alone that the author deals. His researches cover the empire and the United States, whose measures and weights are practically identical with our own, and are intended to be identical, excepting, of course, the gallon, which, in the United States, is, we believe, the old wine gallon of a little over eight pounds of water. We once knew this fact to have some weight in giving an order to an American locomotive firm because of their larger apparent capacity of tender, whereas they were really smaller, the railway officials not knowing that the American gallon was so small. We present this to the advocates of the metrical system. It is curious to note that if we add a tenth to the yard we get very close to the metre, and if we add a tenth to the number of cubic inches in the gallon we get very close to a round number of inches

and to the weight of 10 half-kilograms. The metric ton and the English ton are almost identical, and generally there is so close a resemblance between various units that it is a pity there is not exactness. The tendency at present seems favourable to the metric system. There are strong arguments in its favour, but if it is finally adopted it will for ever, we fear, be an example of a victory for a poorly thought-out system which possesses no merit outside its universality. So far from there being merit in the decimal system, the very reverse is the case. Decimals are fit only for the study, they are wholly unfitted for general use and the use of women, and, as a matter of plain fact, by far the larger number of calculations and money dealings in most countries are effected by women, who spend the bulk of the income of a country in very numerous small purchases. As we have said before, the decimal divisions are not used in metrical countries, but the people buy and sell by the half-kilogram, and speak of the quarter of a half-kilogram. If we are to have the kilogram it ought to be binarily divided for retail purposes. The Americans, who have a decimal system of money, do not use it *in toto*, as witness their half-dollar and quarter, which are binary divisions, and similarly the French use a half-franc.

Sell's Directory of Registered Telegraphic Addresses. Twelfth year. Published by Henry Sell, Fleet Street, London.

We have received the 1897 issue of this directory, which is compiled from official lists supplied by authority of the Postmaster-General. The usual postal telegraph information is followed by several useful sections devoted to telephone regulations for the London-Paris, private, and Post Office Exchange services. The trunk line section gives particulars of the charges for conversation between town and town, and is followed by a complete list of subscribers at a large number of towns in the kingdom, also a list of London subscribers to the London-Paris exchange. A brief description of the cable systems of the world, and a note of the telegraphic tariff per word from the United Kingdom to all parts of the globe, forms an interesting feature. The information regarding telegraphic addresses is supplemented by quarterly revised lists giving the latest particulars.

HOUSE WIRING AT 200 VOLTS.

A correspondent raises several important points which are interesting now that wiring for 200 volts is receiving so much consideration all over the country. Our correspondent states:—

(*a*) That in a certain town he completed the wiring of a building to be supplied with current from street mains at 200 volts.

(*b*) That this was required to be carried out to the rules of the undertakers thereat, and in accordance with the Phœnix Fire Office rules.

(*c*) That the lights are arranged on circuits of not exceeding 3 amperes, with a single pole cut-out on each pole, and a single pole cut-out to each light.

(*d*) The undertaker's rule was that "both wires of each circuit is to be protected by a single pole cut-out."

(*e*) The Phœnix rule is that—"When the maximum current carried by a branch never exceeds 4 or 5 amperes, and this branch is provided by a cut-out on each pole, then no other cut-outs need be used between them and the lights."

(*f*) The undertakers now endeavour to compel the wiring contractor to erect two single pole cut-outs to each light.

1. As to power enjoyed by the undertakers to enforce a new rule (*f*).

It is well known that the Electric Lighting Acts and Provisional Orders give no power to undertakers to enforce wiring rules. (See Wordingham's paper, Municipal Electrical Association, 1896 Convention.) Therefore, failing the obtaining of powers to do so by special Act, or local improvement Act, or by embodying the rules in bye-laws, published by the local authority with and under the consent and approval of the Board of Trade, there is no remedy in the hands of the corporation should the wiring contractor refuse to carry out the ideas which have been formulated in rule (*f*).

The wiring contractor can compel the undertakers to connect, subject to the wiring complying with the simple and precise requirements of the Board of Trade, as set out in the current Board of Trade regulations, under the local provisional order, and a copy of these regulations can be obtained from the undertakers on payment of a fee of a few pence (by section so stated in provisional order). Failing the commencement of supply, the injured party, or tenant, or occupier of the premises in question should appeal to the Board of Trade, who, if they think fit, can require the undertakers to commence supply "within a reasonable time," or to show cause for failing to do so. The penalty incurred is, at the option of the Board of Trade, forfeiture of the provisional order and annulment of the powers therein contained.

2. As to the technical points involved:—

The Phœnix rule provides, in our opinion, ample security in this case. There is no just technical cause or reason for fusing each pole for each and every lamp fixed. The object of fusing is to cut out a faulty section, but if such section does not carry more than 3 amperes, and the branch double S.P. fuses are set to blow at 5 or 6 amperes, as they may well be, then the undertakers and the consumer is amply protected. No good can result from the multiplication indefinitely of S.P. fuses, but it is convenient to insert in each lamp circuit a fuse somewhere which is cut much finer than the branch fuses, and this protects the latter in case of a "short" in lamp-holder or flexible. The branch fuses usually may be relied upon to act in the event of an "earth" coming on a lamp circuit on either pole.

It is certainly not customary to S.P. fuse each lamp wire; experience does not show this excessive precaution to be necessary, and, in our opinion, it is certainly not desirable.

3. As to the rendering of the Rules (*b*), (*d*), (*e*), and (*f*).

The Phœnix rule (*e*) appears to have been more than fully complied with. The rules of the undertakers mentioned in (*b*) included (*d*), and the interpretation of (*d*) is now stated to be that given in (*f*).

Then, firstly, (*f*) is, strictly speaking, a correct interpretation of (*d*), if by the word "circuit" is held to be included the wiring to individual lamps. Secondly, rule (*e*) is better, and more closely allied to common sense than rule (*d*), and as by (*c*) rule (*e*) is following, this should be sufficient.

Therefore, it follows that the undertakers strive to enforce more stringent rules than the Phœnix Fire Office, that they have no legal standing in enforcing their adoption, that their rule (*d*) and interpretation thereof (*f*) may tend to do an injustice to the consumer and his wiring contractor, that such stringent measures are unnecessary, and not the custom in this country, and that current may be demanded without compliance with rules of this character, provided that the provisions of the Electric Lighting Acts, Provisional Order, and Board of Trade Regulations have been duly had in regard.

OBITUARY.

It is with regret that we record the death of Dr. Timothée Rothen, which occurred on 11th inst., at Berne. He was in his 67th year at the time of his decease, and was a Chevalier de la Légion d'Honneur de France.

Dr. Rothen, who was a native of Switzerland, was appointed Director of the Telegraph Administration of Switzerland in 1890, and he represented Switzerland in that capacity at the International Telegraph Conference, which took place at Paris in the summer of that year. He was appointed Director of the International Telegraph Bureau a few months later, on the death of Mr. Frey, which occurred in June, 1890, during the sitting of the Paris Conference.

Among the most important questions with which the Bureau had to deal during Dr. Rothen's tenure of office, were included the German project for a "uniform tariff" in Europe, and the official vocabulary for code telegrams.

Rothen was an exhaustive contributor to the *Journal des Administrations Télégraphiques* and other technical journals, and also compiler of reports issued by the Bureau International. He was a great student in everything connected with electricity, and was also a good linguist. He leaves a wife and three children.

D

MORE MOTORS, MUCH MONEY.

We have before us the prospectus of the London Motor Van and Wagon Company, Limited, share capital £300,000, out of which £150,000 in cash or shares is to be paid to the vendors.

These gentlemen who modestly veil their identity behind the taking title of "The New Traffic Syndicate, Limited," are probably looking forward to a fine time in the future, at the expense of the British public.

The shareholders, on the other hand, will acquire certain considerations for which the English language provides no distinguishing appellation.

According to the prospectus, they consist of—

(*a*) A license from the British Motor Syndicate, Limited, to build motor vans and wagons.

(*b*) An option to take 100 motors from the Daimler Motor Company, Limited.

(*c*) An option from Messrs. E. H. Bayley & Co., Limited, to make the bodies of the vans or wagons to be fitted to such motors.

The *license* does not even appear to be a sole license, or to be free from the obligation to pay royalty to the owners of the patents.

The two *options* to *take* 100 motors and wagons are probably accompanied by the usual obligation insisted upon by such humble tradesmen as the butcher and baker—that they shall be paid for.

We imagine that we should have no difficulty in fixing up half a score such options in the course of a few hours.

The vendors seem to have met with the same difficulty as ourselves in finding words to describe the subject of the deal. They do not call it a valuable property or valuable anything, but simply a license and two options.

On the subject of profits the same trouble follows them. All we learn is that "The profits of this company must be exceptional." That is what we think; in fact, the whole thing is exceptional. Here is a company preparing to fit up London with motor vans to run on *common* roads, and undertaking to pay £150,000 for the privilege, at a time when the most skilful engineers of this and other countries are unable to produce a satisfactory and economical self-contained and self-propelled tramcar to run on *rails*. Under these exceptional circumstances, it is interesting to note that the names and descriptions of the directors do not favour the suggestion that any one of them possesses even the most elementary knowledge of the ways of either motors or promotors.

SIXTY YEARS OF SUBMARINE TELEGRAPHY.

Prof. W. E. Ayrton, F.R.S., gave us the benefit of his information on the subject of "Sixty Years of Submarine Telegraphy," on Monday evening, at the Imperial Institute, in the course of a lecture. In doing so, the professor showed remarkable ability in laying before his audience a quantity of matter such as would be calculated to retain public interest during the time allotted. He gave us an excellent display of analogical models by way of illustration. Some of these had, of course, been seen before—at any rate, on paper—but this says nothing against them.

We shall here content ourselves with a few passing comments on a portion of the professor's remarks, and in regard to what he did *not* say. With reference to his suggestions anent the calculated speed for the first Atlantic cable, the lecturer failed to mention that the core recommended by Sir Charles Bright (the engineer), was close on 400 lbs. copper, with a similar weight of dielectric. Dr. Whitehouse was, however, the electrician; moreover, the funds for a heavier type than that ultimately decided on were not at hand. Prof. Ayrton appeared anxious to draw special attention to the work of Cromwell Fleetwood Varley, sometimes at the expense of his brother, Mr. S. A. Varley, sometimes at the expense of Mr. Willoughby Smith. The latter was certainly responsible for the practical application of condensers for working long cables, though Mr. Varley, amongst his many patents attempted to prove afterwards that he had covered the ground. It will be remembered that Mr. Varley laid his net rather wide in the matter of patents. Similarly, the Institution of Civil Engineers' paper of Mr. S. A. Varley was the first to put clearly the electrical qualifications of a cable as defined by Lord Kelvin, in contradistinction to those of Whitehouse, as annunciated at the British Association, and in the columns of the *Athenæum*. Mr. C. F. Varley's work followed all this. Several rather invidious comparisons and distinctions were made amongst those no longer able to speak for themselves.

Prof. Ayrton showed portraits of Faraday, Sir Charles Wheatstone, Jacob Brett, Sir Charles Bright, Lord Kelvin, Mr. Willoughby Smith, Sir C. W. Siemens, Sir James Anderson, Mr. Cromwell Varley, Mr. Fleeming Jenkin, Mr. Latimer Clark, and Sir Henry Mance.

Surely, John Watkins Brett, the elder brother (who always led the way on the business side of Channel cable matters in his time), should have been included, besides the late Sir John Pender, amongst these. Also Thomas Russell Crampton, who—rather than either of the Bretts—laid the first effective cable; also F. N. Gisborne, who did much good work at an early date. And as the living were being represented as well as the dead, we should have expected to see portraits of Sir Samuel Canning, Mr. H. C. Forde, Mr. F. C. Webb, and Mr. Henry Clifford, as soon as anyone. However, perhaps they were not obtainable; besides which, it was evidently an electrician's night rather than an engineer's, and the professorial element seemed fairly strong. We doubt whether any of the audience would glean much from the published books Prof. Ayrton referred to concerning the subject of his lecture, though they might concerning the few expeditions therein described, as well as in several other books, pamphlets, &c. Surely that of the late Mr. Willoughby Smith would give them more information.

CORRESPONDENCE.

Commutatorless Continuous Current Dynamo.

I have noticed your comment to my letter of the 5th inst., *re* Commutatorless Continuous Current Dynamo.

Cause of failures.—I must confess that I ought to have said "difficulties of mechanical arrangement," and not "mechanical difficulties of construction."

With that correction, I think, we may both be right, that depends on the way of looking upon the matter.

The difficulties are electrical as you say, but it it so on account of the difficulty, with the actual rules exclusively, of contriving a mechanical arrangement such as to render a homopolar dynamo an all-round practical machine.

Fundamental rule.—We are still of the same opinion, but when you know our reasoning we shall be much obliged if you will show us where we are mistaken.

Size of dynamo.—Here we quite agree with you, but we had use for a 200 H.P. dynamo, and the results obtained with the small dynamo referred to in my letter of the 5th inst., gave us sufficient confidence to take the risk of building a commutatorless continuous current dynamo in place of one of our ordinary three or more pole dynamos.

M. Poncin.

February 15th, 1897.

Three-Wire Dynamos.

With reference to your article on above, printed a few weeks ago, would it not be possible to secure better regulation on a three-wire system where there is a motor load overlapping the lighting load by using motors with third brush and divided pole-piece?

Regulation.

Induction in Multiple Core Cables.

My attention has been drawn to the diagram, which accompanied my letter, published in your issue of the 29th ult., and also to the fact that an error has found its way into the text.

The following explanation will probably make the matter clear :—Wherever *two* wires in the sketch are joined on to a condenser, these two wires ought, of course, to be insulated from one another, and each of them connected to a separate condenser. Thus will be seen that three condensers are needed for each receiving instrument, and that 12 condensers, not eight as stated, are requisite, if four cores are to be guarded against induction by this method.

P. Chr. Dresing.

Copenhagen, *February 12th*, 1897.

Cord Grips.

Referring to your description of the ingenious American automatic wire connector, as illustrated on page 219 of your issue of the 12th inst., it may possibly be of some historical interest to your readers to hear that the original cord grip as used in incandescent lamp holders early in 1884 was constructed on a somewhat similar principle. In this case, however, the saw-tooth gripping device was necessarily constructed of an insulator (preferably ivory), and made in two pieces, gripping the twin flexible when the threaded nipple, to which these two pieces were attached, was screwed into the holder body (at that time constructed of wood).

Doubtless this device has long since been forgotten, as it was shortly afterwards superseded by the single split cone method (which in its turn gave way to the double split cone now so universally employed) on account of its cost.

I am able to send the only remaining sample for inspection herewith.

Gus. C. Lundberg.

Electricity v. Compressed Air.

In your issue of December 25th, 1896, I note a letter by Mr. A. L. Steavenson, in which he makes several attempts at criticising my article on "Electricity *v.* Compressed Air" appearing in the *Electrical Engineer* of New York, November 25th, 1896.

My object in writing the article was to bring before those interested in the subject actual working data of the two plants operating side by side under similar conditions, and I believe this is the first real comparative test ever published. The article is simply a rehearsal of facts as I found them, and it cannot be said that I attempted to hide any defects of the air plant, for in fact they are very clearly indicated. It must also be considered that the electric plant was working under disadvantages due to underloading of both engine and pumps. I have noticed that the air men are very ready with figures on paper to attempt to show that compressed air transmission is more efficient than electricity, but I have yet to find a man who will show records of a compressed air pumping plant where the efficiency is anywhere near 50 per cent.

Now, regarding the particular criticisms. I have no doubt that our critic has written many interesting and instructive (?) articles, of which the one about "headless ones in charge of mines" is probably the latest and the best, but not having read his best I fail to see the application. Our critic states—"The description of the pumps with their pipes is so obscure in its wording, that I do not attempt to unravel it; but . . . ." and then he describes the situation exactly. If this can be done without an "attempt to unravel it," the description must certainly have been *very* clear. He goes on to say: "Of course, it was no part of Mr. Searing's business to ascertain why the air plant was giving less than 9 per cent., when, as Prof. Unwin has shown, that under intelligent care it might have afforded from 44 to 51 per cent." As there was nothing in the article to show whether the cause of the inefficiency of the air plant was investigated or not, he is not justified in his assumption that this was overlooked. As a matter of fact, the plant was in good working order when tested, as it necessarily had to be to do the work required, and both the chief engineer and general master mechanic of the Fuel Company were there to take part in the tests, and no doubt were interested sufficiently in having their own work fairly treated, to know "how the tests were conducted," much better than any air man could from "a copy of the diagrams."

Although Prof. Unwin may have shown (on paper) that air transmission may have an efficiency of from 44 to 51 per cent., has he *proved* this to be the case under working conditions, and with a mine pumping plant? Assuming the 44 per cent. could be obtained under exceptional conditions, how is the evil effect of operating this plant at an altitude of 6,000 feet above sea level to be counteracted, as it would have to be in the plant described. Our critic makes no mention of this point, and has perhaps never encountered a problem involving high altitudes. Take Prof. Unwin's plant to an altitude of 6,000 feet, and his efficiency of 44 per cent. would drop to about 37 per cent. At 10,000 feet, an altitude very common in Colorado, his efficiency would drop to 32 per cent. Give Prof. Unwin the direct acting pump universally used in the U.S., instead of a complicated and delicate air *engine* to operate with his compressed air, and his efficiency would be nearer 9 than 37 per cent.

To our critic's question, "Why was the air not cooled by water *injection* during compression?" I would answer because it was cooled by a water *jacket*, as described. The expense of constructing these water jackets which our critic states as being "of no value at all," was undergone by the compressor manufacturers just for fun, and although I have seen the compressors run so smoking hot as to cause a shut down wherever the water pipes to the jacket clogged up, yet the "headless ones in charge of the mine" would persist in the pernicious use of these same jackets. Our critic's method of ascertaining the leakage in the pipes is unique; "let the engine stand, and ascertain how long it required for the pressure in the pipes to drop to zero." Determining the leakage to be so many minutes, hours or days, would be of little value, considering the pipes were conveying air, and not minutes or clocks.

The "slip-shod" calculations which he says contain an error of 22 per cent., are, perhaps, not so "slip-shod" as his assertion proves our critic's limited experience to be, for he has evidently used *imperial gallons*, whereas in the U.S. we naturally use U.S. gallons. If he will go over his figures using U.S. gallons, he will not only find no error in my figures, but a mistake in his computed error of 9·1 per cent.

Lewis Searing, *Consulting Engineer,*
The Denver Engineering Works Company.

January 19th, 1897.

Generous!

I have just read E. P. C. C.'s letter in your issue of the 29th ulto., and from his statements, and what I know myself, I think things in Cheshire are all done on the cheap.

I know of a certain Council who have adopted and just completed a central station, who pay the following munificent list of salaries:—

Resident engineer	£150 per annum.
One switchboard attendant	25s. per week.
One engineman	28s. "
One "	26s. "
One jointer	8s. "

This lot comprise the "staff," of which the switchboard attendant is the only one of the assistants who has had practical experience before. The two enginemen were firemen a few weeks ago, and the "jointer" was a "boy plumber" fixing "penny-in-the-slot" gas meters.

If this is not a scandalous state of things for the electrical profession, I don't know what is.

Why on earth the contractors who do the work, and who we know very well have to give a guarantee with it, don't insist upon proper thoroughly practical men being engaged, I cannot understand.

I think it is high time something was done to stop this "butchery," and give men who have spent both time and money a chance.

If anyone in the profession can suggest anything, if he will send his address through your valuable paper, I should be happy to communicate with him.

Trusting you will find space for this letter.

Justice.

The Validity of the Use of Sine Curves in Alternating Current Problems.

I am pleased to note that in a recent number of the Electrical Review (December 25th, 1896, page 845), Mr. Rhodes has given an outline of the proof that "The virtual values of functions containing only odd harmonics depends solely on the amplitudes of these harmonics, and is independent of their phase positions," and that he has called attention to the bearing this has in justifying the use of the polar diagram in the solution of alternating current problems where hysteresis is present. I would call your attention to two minor errata.

In the fourth paragraph from the end, the statement that equivalent sine curves are sine curves of equal area, is misleading. When we speak of a sine curve, the very expression implies that we have plotted a curve of sines with rectangular co-ordinates. In this case the sine curve of equal area is not equivalent. The given curve and the sine curve are equivalent when curves plotted from the squares of their instantaneous values have equal areas.

In the last paragraph the writer makes reference to Bedell and Crehore's work in American journals. In justice to Prof. Boyd, I must say that the work which Mr. Rhodes publishes is taken directly from a paper by F. Bedell and J. E. Boyd on "Effect of Hysteresis and Foucault Currents on Polar Diagrams," published in the *Electrical World*, July 18th, 1896. The same is given in my recently published book on the "Principles of the Transformer," page 391.

Frederick Bedell.

January 22nd, 1897.

Concentric Wiring.

Admirable as are the systems of concentric wiring now on the market, there can be no doubt that, as pointed out in the interesting communication published in a recent issue, there are cases where something further is required.

In many cases the present systems are all that can be desired; but where the wiring has to be buried in plaster, behind tiles, or in concrete floors, and has to stand rough usage whilst the building is going up, a combination of the "draw through" and the "concentric" methods certainly seems to offer many advantages. What is wanted is an insulated conductor and a pipe to form at once a mechanical protection, and a means by which the wire can be replaced if necessary, without disturbing decorations. If this pipe takes the return current, we get about the simplest arrangement possible, and one which, at the same time, will meet the full approval of the fire insurance companies.

We have recently specified such a method in some of the installations carried out under our direction.

It consists of running from distribution boards fixed at convenient centres, 3/20 vulcanised rubber wires in solid drawn Muntz metal tubes (which have the advantage of being easily bent cold) $\frac{3}{8}$ inch diameter, with cast-brass joint and switch-boxes, the pipes and boxes forming the return conductor. Joints between pipes are easily made by butting the ends, slipping a brass sleeve over the joint, and soldering with a blow-lamp. Each circuit carries about six lights, and joints in the inner conductor are made in the boxes in the usual manner with rubber tape and vulcanised. "Tumler," or any ordinary pattern switches are used; the boxes carry flush with the plaster line, with the switch handle projecting through a fancy cover plate. At bracket and pendant points either the ordinary concentric attachments are used, or a brass plate is screwed to the patera, and the end of the tube brought through it and soldered. The insulated conductor is run straight from the lamp-holder to the joint-box in the floor below, and the bracket is screwed to the brass plate through the usual screw holes.

Centric contact concentric lamp-holders are, of course, used throughout.

Owing to the small size of the pipes, very little cutting away is necessary, and for the same reason they are mechanically very strong. It is almost impossible to drive a nail through them, as unless it strikes the pipe exactly in the centre, it tends to be deflected to one side or the other.

It might not at first sight appear to be an inexpensive system, on account of the cost of brass tubing; but owing to the small size of the tubes, the ease with which they can be fixed to the walls, bent and jointed, and the small amount of cutting away, it makes in practice a very economical installation.

Before the plastering is begun, the pipes and boxes are quickly fixed in position by comparatively unskilled labour, and covers fitted to the boxes. Then when the plastering and decorating is finished, the wires are drawn in, and the switches and fittings fixed, with the minimum risk of damage to either.

In comparing this with a double wire conduit system, many advantages are at once apparent. Not only is there only half the amount of wire, and half the weight of metal in the tubes, but the tubes themselves are stronger and easier to work and erect, whilst in addition there are the well-known advantages of the concentric system as regards leakage, insulation, and safety.

It is not contended that this idea is novel, or that it is applicable in all cases, but it certainly appears to possess qualities which render it worthy of consideration, now that so many different systems of wiring are on their trial.

Handcock & Dykes.

Mordey's Inductor Alternator.

In the description of Mr. Mordey's new inductor alternator, which appeared in your last issue, great prominence is given to the question of regulation; the drop between no load and full load being described as exceptionally small for an iron-cored alternator. Now, it has long been known that there is no difficulty in making such an alternator to have just as good regulating properties as a machine without iron in the armature; there is really, when one comes to think of it, no essential difference between the two; but most iron-cored alternators have been designed, up to the present, so that the current on short circuit is not excessive; that is to say, it will not rise to such an extent as to do damage to the machine itself or the circuits, or other machines to which it may be connected. This advantage, it is quite evident, can only be obtained by sacrificing to a certain extent the regulating qualities of the machine.

An alternator giving an E M.F. curve such as the one reproduced on page 213 of your last week's issue, would undoubtedly stand short-circuiting during the time required to blow the main fuses, as, of course, no question as to mechanical strength would arise in connection with an iron-cored alternator; but when the Brush Company claim for their machine ability to stand short-circuiting, this is naturally understood to mean that the current through the windings when the terminals of the machine are joined across will not rise to an excessive value, which statement is in total disagreement with the claim of exceptionally good regulation.

X. Y.

A Disclaimer.

We have just noticed a company being brought out for £300,000 as "The London Motor Van and Waggon Company, Limited." Now some months ago we registered in the name of the London Motor-Car Works Company, Limited, our memorandum of association, specially providing for the manufacture of vans, wagons, &c.

It is only fair to us to state that we are in no way, directly or indirectly, associated with the London Motor Van and Wagon Company, Limited, and shall take the necessary steps to stop them using a colourable imitation of our title.

The London Motor-Car Works Company, Limited.
James Rickard, *Managing Director.*

The Albert Mills, Hammersmith, W.
February 17th, 1897.

LEGAL.

Electrical Installation Company *v.* Armfield.

In this case, which was heard before the Lord Chief Justice and a special jury, and was partly reported in our last issue, Mr. Edward O'Brien, an electrical engineer and a member of the company, when the hearing was resumed, gave evidence bearing out the statement of counsel, and said that the whole of the contention with Lord

Stratheden and Campbell was in connection with the water and turbine. Mr. Armfield was not an electrical engineer, and knew nothing about installations. Witness did not tell Lord Stratheden and Campbell that he learnt from Mr. Armfield that the water was insufficient; he, however, did tell Lord Stratheden and Campbell that in the summer months the water might be short. An independent engineer reported there was ample water in the burn to supply the electric light for 10 months in the year. They could have had recourse to steam or oil. Lord Stretheden and Campbell did the dam and reservoir himself. There was no direct guarantee as to the efficiency of the turbine, but an inferred one in the defendant's report that the turbine was efficient up to 75 per cent. Witness then spoke as to the testing of the turbine.

After a considerable amount of further evidence had been called for the plaintiffs, his Lordship suggested that it was a case for settlement, and after a consultation with him in his private room, it was announced that the parties had come to terms, which were not stated. His Lordship, however, mentioned that all imputations upon the defendant in regard to this work had been withdrawn, and he also complimented the plaintiffs' representative upon the straightforward manner in which he had given his evidence.

The Edison-Bell Phonograph Company *v.* Henry Proctor.

In the Chancery Division of the High Court on Thursday last week, before Mr. Justice North, it was mentioned that in this case, which was a motion for an injunction to restrain infringement of the plaintiffs' patents, the defendant had consented to a perpetual injunction, the payment of costs, and delivery up of the infringing articles.

PHYSICAL SOCIETY.

A special general meeting was held on February 12th. The chair was taken by Capt. Abney who, as retiring president, referred to some of the changes which had occurred in the society during the past year. The annual subscription had been raised, but a satisfactory number of new fellows had been enrolled. The society had lost two by death. A good deal of work had been done in the direction suggested by the discoveries of Röntgen.

The treasurer, Dr. Atkinson, then presented his report and balance-sheet for the year 1896. There was evidence of improvement in the financial position, but there was still a deficiency to be met. Profits from sales of publications had been small; it was desirable to reduce the price of the volumes of Collected Papers of Joule and Wheatstone, and to call the attention of physicists to these valuable records of classical work.

Mr. Walker suggested that physical laboratories, especially those in London, should be visited by fellows of the society, with a view to comparing notes as to the construction of apparatus; professors of colleges and other institutions should be invited to appoint visiting days for this purpose. Votes of thanks were passed to the retiring president, council, and officers, and also to the council of the Chemical Society for the use of their rooms at Burlington House.

In replying, Capt. Abney said that the coming year would probably bring about further improvements in the system of abstracting and indexing, by co-operation with other societies at home and abroad. He then read the list of council and officers for the year 1897-8:—President, Shelford Bidwell, M.A., LL.B., F.R.S.; vice-presidents, who have filled the office of president, Dr. Gladstone, Prof. G. C. Foster, Prof. Adams, The Lord Kelvin, Prof. Clifton, Prof. Reinold, Prof. Ayrton, Prof. FitzGerald, Prof. Rücker, Capt. Abney; vice-presidents, Maj.-Gen. E. R. Festing, L. Fletcher, Prof. Perry, G. Johnstone Stoney; secretaries, T. H. Blakesley, H. M. Elder; foreign secretary (new office), Prof. S. P. Thompson; treasurer, Dr. Atkinson; librarian, C. Vernon Boys. Other members of council, Walter Baily, L. Clark, A. H. Fison, Prof. Fleming, R. T. Glazebrook, Prof. A. Gray, G. Griffith, Prof. Minchin, Prof. Ramsay, J. Walker. The newly-elected president, Mr. Shelford Bidwell, then took the chair, and an ordinary meeting was held.

BUSINESS NOTICES, &c.

A Visit to Messrs. Nalder Bros. & Thompson's Workshops.—Some days ago we had the privilege and pleasure of going through the workshops of Messrs. Nalder Bros. & Thompson, of Queen Street. It is scarcely necessary to say that this business is an offshoot of the well-known firm of Messrs. Nalder Bros. & Co., of Red Lion Street; the partners are Mr. F. H. Nalder (who still retains his connection with the older firm), and Mr. Thompson, and these gentlemen are devoting their energies to the manufacture of the well known N. C. S. ammeters and voltmeters. The works at Queen Street have been in existence some six months, and though it was practically a transference of a part of the Red Lion Street manufactures, it was astonishing to find so much organisation reigning. The making of instruments that have the precision of the N. C. S. type needs some accurate tools, and there are at Queen Street some excellent specimens of the American machine. Interchangeability is the one important feature in the making of the Nalder instruments, and this, no doubt, accounts in a great measure for their general reliability and their moderate price. On the occasion of our visit, in addition to the general manufacture of voltmeters and ammeters, we noticed that there must be a considerable demand for large dial instruments, judging by the number that were being turned out. The Queen Street House, or as it may be termed, the "Sign of the Golden Ammeter," does not confine its attention solely to instrument work, for of the making of switchboards, resistance frames, automatic cut-outs, &c., there is no end.

Electrical Wares Exported.

Week Ending Feb. 16th, 1896.	£	s.
Algoa Bay	11	0
Bombay. Teleg. mat. ...	78	0
Brest. Teleg. cable ...	1,500	0
Brisbane. Teleg. mat. ...	250	0
Brussels	60	0
Calcutta	40	0
Cape Town	409	0
Colombo	73	0
Copenhagen	13	0
East London	1,332	0
Gothenburg. Teleg. mat.	120	0
Hamburg. Teleg. mat....	107	0
Hong Kong	101	0
King George's Sound ...	73	0
La Plata	158	0
Laurenço Marques. Teleg. mat.	682	0
Liban	530	0
Madras	32	0
Melbourne. Teleg. mat.	38	0
Monte Video	60	0
Oporto	20	0
Penang	9	0
Port Natal	331	0
Rangoon	60	0
Shanghai	42	0
Singapore	15	0
" Teleg. cable	10,550	0
Suez. " "	13,200	0
Sydney	430	0
Wellington	201	0
Yokohama	456	0
Total	£30,981	0

Week Ending Feb. 16th, 1897.	£	s.
Albany	158	0
Alexandria. Teleph. mat.	140	0
Amsterdam	50	0
Auckland	328	0
Brisbane. Teleg. poles	526	0
Bombay. Teleg. mat. ...	59	0
Brussels	10	0
Calcutta	790	0
Cape Town	321	0
Corfu. Teleg. mat. ...	23	0
Durban	408	0
East London	340	0
Gothenburg	8	0
Hamburg. Teleg. mat.	225	0
Hobart	31	0
Malaga	155	0
Port Elizabeth	161	0
Rotterdam	276	0
Shanghai	527	0
Sydney	1,181	0
Trinidad. Teleph. mat.	48	0
Wellington	560	0
" Telephones	2,320	0
Total	£8,644	0

Business Announcement.—We are informed that the Glasgow branch of Messrs. Paterson & Cooper has recently been purchased by Mr. Wilfrid Marshall, who has been with the above mentioned firm for many years, and will henceforward be carried on by him at 137, West Regent Street, Glasgow, under the style of Paterson, Cooper & Co.

Change of Address.—Messrs. J. H. Holmes & Co. announce that their London address is now 17, Soho Square, W.

Continental Installations. — We have received a gorgeously got up album from the Deutsche Elektrizitäts Werke at Aachen, containing illustrations of some 70 examples of electric plant which have at one time or another been constructed and installed by the said company. The H.P., voltage, &c., are given in each case, and also the name of the parties to whom the plant has been supplied. The sphere of the company's activity appears to have been very extensive: dynamos and motors, direct, alternating and drehstrom, transformers, presses, cranes, power transmission for machine tools, ice-making machinery, railway shunting, portable pumps, &c. We notice an ingenious arrangement of turning lathe and direct coupled motor, in which the power is transmitted from the motor to the lathe spindle by variable friction gearing, thus dispensing with the somewhat troublesome time-honoured belt and cone pulley gear.

Deed of Assignment.—A deed of assignment for the benefit of creditors has been executed by James Stott, electrician, Bowkers Row, Bolton, under which Mr. Alfred Platt, chartered accountant, The Albany, Mawsdley Street, Bolton, is trustee. The unsecured liabilities are returned at £180, and the assets, after deducting the claims of preferential creditors payable in full, are returned at £50.

Electrical Water Level Indicator.—The Perth Water Commission, on 8th inst., inspected a new electrical water level indicator and recorder, which has just been fitted up in the engine room at the works. The Glenfield Company, of Kilmarnock, executed the machinery department of the work, and the Faraday Electrical Engineering Company, of Govan, the electrical part. The apparatus is the patent of Messrs. Barr & M'Whirter.

Gas.—On 8th inst. a gas explosion did a good deal of damage at Fosse Road, Leicester.

On 9th inst., at Stevenson Street, Paisley, a gas explosion occurred with the usual results.

Some days ago an American, who was staying at Leamington, was found in his bedroom unconscious, and died an hour later, the cause being suffocation from gas through a leakage.

A serious gas explosion occurred at Newport on Sunday, three persons being injured.

At Cornholme, near Todmorden, on 15th inst., there was a gas explosion, which did damage to life and property.

Meetings of Creditors.—A meeting of the creditors interested in *re* Chalmers, Paterson & Co., electrical and telephone engineers, 154, West Regent Street, Glasgow, has been held, at which a statement of affairs was submitted, showing liabilities amounting to £1,086, and assets as follows:—Stock in trade, estimated to produce £51; book debts valued at £50; estimated value of telephone instruments, wires, &c., £286; telephone rental valued at two years' purchase, £502—total assets £889, from which £51 has to be deducted for the claims of preferential creditors payable in full, leaving net

assets at £837, and a deficiency of £248. The creditors decided to appoint a committee to endeavour to find a partner with sufficient capital to work the business properly.

At a meeting of the creditors concerned in *re* Hurry & Young, electrical engineers, 30, South Hanover Street, Edinburgh, a statement of affairs was presented, showing liabilities amounting to £766. No offer of composition was made on behalf of the debtors, but the meeting appointed a committee of inspection to investigate the debtors affairs and report to an adjourned meeting.

Gauge Glass Reflectors and Protectors.—We illustrate below (figs. 1 and 2), the "Evertrusty" luminous gauge glass reflector, which when fixed behind a gauge glass produces an effect which indicates correctly the height of the water in the glass. This

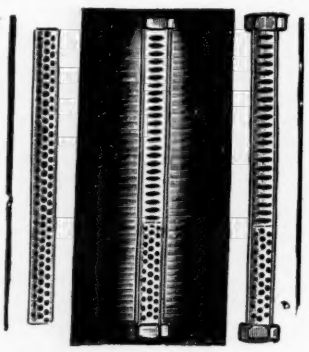


Fig. 1.

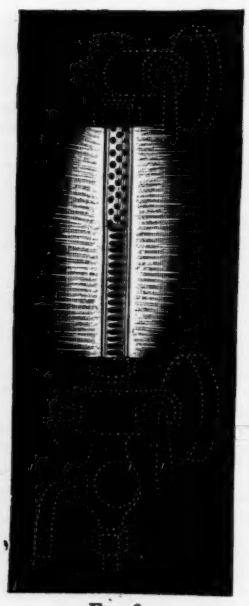


Fig. 2.

Fig. 3.

effect is equally visible in the dark as in the light. The reflector is perforated throughout its entire length with rows of round holes, of which those that are seen through the portion of the gauge glass filled with water appear to converge, each row of three thus becoming one narrow elliptical hole horizontally disposed. On the other hand, those that are seen through the upper portion of the glass, where there is no water, are not affected, and the observer is thus enabled to easily see whether the water is at the proper height in the gauge glass. The distinction between the two parts of the tube is very sharp, the lower part (where the water is) appearing as a series of elliptical holes superposed, and the upper part (which is empty), as a number of rows of round holes. The reflectors are supplied either plain enamelled, or prepared with luminous paint. Fig. 3 shows the patent gauge glass protector, made of wire netted glass, toughened by a special patented process, which is claimed to be a most effective safeguard against injury by broken glass thrown about by the bursting of gauge glasses. The protector is of specially toughened glass moulded on wire netting, which is thus embedded in the centre. It is of horse-shoe shape. The method of attaching the patent protector to the gauge glass is by two closely coiled spiral springs, which passing round the protector, are fastened to clamps connected by a rod, and fitting closely to two of the sides of the upper and lower hexagonal nuts respectively. This arrangement not only keeps the protector firmly in position, but also acts as a kind of buffer, as, should a gauge glass burst, the protector will yield through the stretching of the springs so as to minimise the force of the shock. Messrs. Wallach Bros., of 57, Gracechurch Street, E.C., are the sole licensees.

Munich Motor Exhibition.—On the occasion of its fiftieth jubilee, the General Industrial Association of Munich, in co-operation with the Polytechnic Association of Munich, is organising an exhibition of motors and machine tools with special regard to the requirements of small manufacturers. The exhibition is under the patronage of H.R.H. Prince Luitpold, Regent of Bavaria; it enjoys the support of the Bavarian Government as well as that of the Municipality of Munich, and the outlay is guaranteed by a special fund. The engineers machinists of all countries are invited to send machines or models. The programme, which has been placed before us by the Consul-General in London, states that the object is to exhibit such machines and auxiliaries as tend to improve industry and the arts, as well as to instruct and encourage manufacturers and make them acquainted with the value and importance of making the best use of the forces of nature by means of the scientific and technical inventions and improvements of our day. With this object, the exhibition will contain motors, machine tools, hand tools, implements, apparatus and machinery in motion, as well as the materials to be worked up, and the manufacturing processes in operation; accordingly, motors over 10 horse-power, and tools or machines requiring greater driving power, such as steam hammers, lathes, rolling machines, and the like, will be excluded. Popular lectures on special scientific and technical branches will be delivered, and technical literature on these subjects will be exhibited. The exhibition will be held on the so-called Kohleninsel, which belongs to the Municipality, and is near one of the most crowded thoroughfares of the capital. It will be opened on June 11th, 1898, and closed on October 10th. The exhibition comprises five groups, divided as follows:—

Group I.—Motors, gas, petroleum, benzine, steam, and hot-air engines, machinery driven by water and wind power, and electromotors up to 10 horse-power.

Group II.—Machine tools, hand tools, and implements.

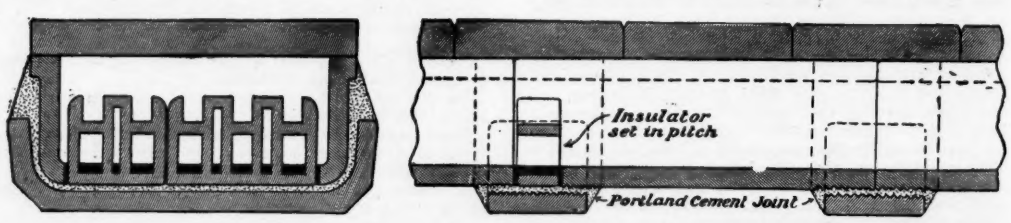
Group III.—Auxiliary machines, as pumps, ventilators, presses, cranes, clocks, parts of machines, electrical arrangements, safety appliances, apparatus, and auxiliary materials.

Group IV.—Manufacturing processes in operation and machinery in motion.

Group V.—Special technical literature.

The board of directors is made up as follows:—Honorary President, His Excellency, Baron Max von Feilitzsch; Honorary Vice-President, Wilhelm von Borscht, Mayor of Munich; President, Max Nagler; Vice-President, Georg Leib; Deputy Vice-President, Egbert von Hoyer. For further particulars, application should be made to M. Nagler, or the directors, 1½, Färbergraben, Munich, Bavaria.

Culverts for Bare Copper Mains.—The illustration shows a new type of culvert for bare copper mains, designed by Mr. T. H. Tonge, the engineer to the National Electric Supply Company, of Preston, in conjunction with Doulton & Co., which has recently been adopted for an extension of mains at Preston. Hitherto such mains have been in nearly all cases laid in culverts constructed *in situ* of concrete or brickwork, or in iron culverts. The culvert used at Preston is constructed of sections of strong glazed stoneware, 2 feet long, which are bedded in Portland cement on stoneware cradles at the joints. Every third section of culvert is made with a recess for the reception of an insulator, which is secured with pitch. The insulators are of glazed vitrified stoneware, of the pattern used by Prof. Kennedy, and supplied by Doulton & Co. for the electric lighting schemes at Aberdeen, Oldham, Belfast, Edinburgh and Sunderland. Prof. Kennedy's system of laying the copper strips on the flat in slots in the insulators, has been adopted at Preston. This system permits of the section of copper in each slot being increased to one square inch, by drawing in extra strips after the culvert has been laid. The culvert is covered with flags set in cement. Beneath the culvert a 3-inch stoneware pipe has been laid to receive pilot wires, &c. The cost of laying the culvert was carefully noted, and it was found to compare favourably with that of concrete, and further, the ground was kept open not more than about half the time that would have been necessary had concrete been used.



Newcastle Exhibition.—We understand that the Electrical and General Engineering Exhibition was opened on Monday last. For 12 weeks only operations had been in hand, under the management of Mr. H. Engel. The exhibitors exceed 200 in number, a great deal of the space having been taken by local electrical and engineering firms. The premises are completely lighted by electricity, the arrangements being managed by Messrs. Ernest Scott and Mountain.

Technical Terms of the Railroad.—Mr. Lucien Serraillier has compiled, and Messrs. Whittaker & Co. will shortly publish, a "Technical Railway Vocabulary," giving over 5,000 French, English, and American technical terms used in railway management, construction, and working. The book is destined for the use of engineers, railway men, contractors, company directors, financiers, lawyers, patent agents, and inventors.

The "Premier" Arc Lamp.—Mr. Joseph Edmondson, of Bradford, has issued an illustrated card of the "Premier" arc lamps ("Series-Duplex" or "Single" type). The difficulty experienced by engineers about to adopt the system of high tension supply is the adaptation of arc lamps to its requirements when it is inconvenient to have more than two lamps. Mr. Alfred H. Gibbings, borough electrical engineer at Bradford, is stated to have completely solved the question by having two lamps placed on one base and coupled "in series." Thus two 5-ampere "Series-Duplex" lamps take the place, across a 230 volt circuit, of two 10-ampere lamps of the ordinary type across a circuit of 115 volts. The design of cover gives complete protection from the weather. The arrangements for lowering, raising, and fixing the globe for re-carboning are simple and convenient. The list states that the mechanism of the lamp (Edmondson's patent), though very simple, ensures the perfect "striking of the arc" and the most accurate adjustment of the "feed" of the carbons. The success of the Series-Duplex "Premier" arc lamp has persuaded the maker to produce a lamp of the single carbon type for the general trade.

ELECTRIC LIGHTING NOTES.

Bath.—The Gas Inspector (Mr. J. W. Gatehouse) reports to the Surveying Committee, in regard to the unsatisfactory condition of the electric lighting, that it is possible for a breakdown to occur at any time. Alderman Sturges stated that that was what Mr. Hammond told the Committee, *i.e.*, that the machinery at the works was defective, and not sufficient for the work it had to do. When the money granted by the Local Government Board for improved machinery and new standards had been expended, and the new standards erected, he did not think they would have any report of that sort. They were in the way of making a great improvement, and he hoped they would make an improvement in the price, too. He wanted to introduce what was called the Brighton system. Attention was called to the fact that 74 gas lamps had been found out during the fortnight, and it was stated that under the agreement with the company they could not be fined. Alderman Sturges said they would have a little more power with the company now they had the electric light.

Bingley.—The Gas Committee has carefully considered the offer of the Leeds and Liverpool Canal Company to supply electricity—to be generated by the fall of water at the locks at Bingley—at the rate of 4d. per unit. An expert has reported that it would be by far the cheaper way for the council to generate their own current, and that it would be necessary to have a consumption of from 50,000 to 60,000 units per annum to make a profit on the basis of a charge to the public of 6d. per unit. This would mean a total return of £1,500, or about one-seventh of the total value of the gas sales last year. The council decided to thank the Canal Company for their offer, and to state that they could not accept it in view of the expert's report.

Blackburn.—A meeting of consumers was held on Tuesday at the Castle Hotel, when the question as to the charges made for current was under consideration. A deputation was appointed to bring the matter before the Corporation, and a petition was drawn up asking for a reduction to 4d. per Board of Trade unit, and a discount of 5 per cent.

Bootle.—Mr. T. L. Miller, A.M.I.C.E., M.I.M.E., M.I.E.E., has been appointed by the Town Council to carry out the electric lighting scheme for the borough.

Brighton.—Mr. Magnus Volk, of seashore electric railway fame, has written to the *Sussex Daily News* with reference to the recent reductions in the Corporation charges for current, stating that after measuring all the current generated by his 20 H.P. gas engine for one month, the current being used for driving the electric cars, he found that the cost of gas alone worked out at 2½d. per unit, to which attendance, oil and waste, and depreciation had to be added. Mr. Volk says that had he known that electric current would ever be sold at so low a price as that now decided upon at Brighton, he would never have incurred the heavy expenditure upon the Brighton and Rottingdean railway plant. He expresses his intention to take advantage of the town supply instead of putting down duplicate plant.

Cardiff.—The Building Committee of the Union Workhouse has considered and adjourned the proposal to light the buildings by electricity.

Gas v. Electric Light.—The Chairman of the Chester United Gas Company (Mr. J. Gamon), in the course of his half-yearly address to the shareholders, on the 8th inst., said that the proprietors, and especially those who were in any way connected with the city, had sufficient public spirit to be proud of the position which Chester held as compared with other cities of its size and population in making public improvements and providing public advantages. The company must admit that the electric light possessed advantages over gas as an illuminant for certain purposes and certain places, and were glad that Chester should possess every advantage that the scientific knowledge and engineering skill of the present day could give by way of lighting. But, in making that admission, it must be remembered that gas possessed advantages over electric light for certain purposes and places, and that gas was considerably cheaper than the electric light. He pointed out that in any town where the electric light had been introduced the profits of the gas company had not been materially affected or the dividends reduced.

The Lord Mayor of York, at the meeting of the York United Gas Light Company, on 4th inst., said that gas still appeared to hold its own. The Corporation of Leeds were asking for a loan of £100,000 to extend their gasworks, and they all knew that the people of Leeds had had the electric light for the last 10 or 12 years, and therefore it appeared that the company had nothing to fear from the opposition of electric light. They would have opposition, but he thought they should not be losers by having the electric light brought to York. He felt sure they would have to face that soon.

Colwyn.—The District Council has arranged with Dr. J. Hopkinson to report upon the schemes sent in for lighting the district electrically.

Colchester.—A canvass of the town shows that out of 236 possible customers who had been visited, 45 would take the electric light; 93 would not bind themselves; 47 were not prepared to take the current at the moment, but probably would later; 28 would like to consider; and only 23 refused, and that not from objection to the light, but because they thought it was not for the Corporation to undertake such a matter as the supply of light to private consumers.

Consett.—The Special Committee appointed to consider the question of lighting the town by electricity, has reported that the cost of such illumination at Witton Gilbert is £1 5s. per lamp, while at Consett £2 per lamp is paid for gas.

Dewsbury.—The Council's electrician reports that the result of the working of the installation during 1896 was a net profit, after defraying all expenses, including interest and sinking fund, of £19 19s. 9d. He reports that the consumption of gas for some weeks past has shown a decrease.

Folkestone.—We are informed that, under an agreement dated January 27th, 1897, the Corporation of Folkestone have transferred their powers, under the Folkestone Electric Lighting Order, 1896, to Mr. Walter Hopkins, of 30, Parliament Street, Westminster, who has undertaken to form a company to carry out the necessary work.

Godalming.—Messrs. Kincaid, Waller & Manville, who were consulted by the Council, have reported against the adoption of the alternating current transformer system. They suggest only, for the present, the laying of the mains in the compulsory streets named in the provisional order, and propose that the 32 public gas lamps in these streets should be each replaced by two incandescent lamps of 16 C.P. each. The total cost of providing for 4,000 private lamps of 8 C.P., and 32 public lamps, was put at £13,600. The annual revenue for 4,000 lamps, each consuming 20 B.O.T. units per annum, 80,000 B.O.T. units, at 8d., was estimated at £2,666, and the annual maintenance at £1,266, showing a gross profit of £1,400. The interest and sinking fund amounts to £714, which, deducted from £1,400, gives a net profit of £686. Should the Corporation decide to charge only 7d. per unit for the supply of current, in place of 8d., the net profit would be reduced by the sum of £333. A personal canvass in the compulsory streets had resulted in applications being made for 2,800 lamps of 8 C.P. The committee recommended the Council to proceed with the scheme, and to authorise the committee to acquire a site, and make preparations for applying to the Local Goverment Board to sanction a loan of £14,000. The Council, after discussing the matter, adopted the recommendations by 13 votes to seven.

Grantown.—The Committee having the subject in hand, unanimously agreed last week that the electric light should be introduced, water power of the Spey being utilised for the purpose. It was resolved to ask Prof. Kennedy, or some other electrical expert, to report as to which side of the Spey would be most suitable.

Halifax.—The Electricity Committee have decided to make a reduction in the charge for electric current of 1d. per unit for lighting purposes, and ½d. per unit for motive power. The charges will be thus be 5d. and 2½d. per unit respectively.

Hampstead.—It is stated that there is a feeling among vestrymen in favour of using incandescent lamps for the electric lighting of the side streets of the district.

Handsworth.—The District Council is to apply for a £2,200 loan for electric lighting plant for the Council House, Technical School, and other buildings.

Holborn.—The suggestion of the L.C.C. to the Holborn Board of Works, that a clause be inserted in the County of London Company's provisional order providing for the purchase of the electric lighting undertaking, was made too late in the day, as the Board of Trade has already approved of the order without any such condition.

Hull.—On the recommendation of the Borough Engineer, the Brighton system is to be adopted in connection with the lighting of the Market Hall. It has been suggested that smaller consumers should be placed upon a similar footing.

London.—The London County Council had before it on Tuesday the tender of Messrs. Laing, Wharton & Down, Limited (£4,700), for wiring, &c., in connection with the installation of the electric light at Blackwall Tunnel.

At the Farringdon Ward Club, on Wednesday, 10th inst., Mr. C. W. Sax opened a discussion upon the lighting of the Central Markets, with a view to correcting misleading statements which had been made with regard to the electric light. The charges made for electricity, and the question of measurement thereof, and other points, were considered.

On the 10th inst., the St. James's end of Pall Mall was lighted by electricity for the first time.

Margate.—The General Purposes Committee recommends the Council to obtain estimates from Messrs. Harraps, Duffield and Co., to light the compulsory area with electricity. The report will be considered by the Council in committee.

Morley.—For the management of the electric lighting of the Town Hall, the Council is to appoint a permanent electrical engineer.

Newington.—The Commissioners of Baths and Wash-houses are to consider, with a special Vestry Committee, the question of lighting their buildings by electricity.

Paisley.—The Public Commissioners have resolved to ascertain the probable cost of supplying and erecting arc lamps for the principal streets, and glow lamps for the side streets.

Paris.—The Electric Municipal Committee has conferred with the representatives of six large electric lighting companies, whose agreements with the City of Paris will expire in 1905. The sum and substance of the argument laid down was that, for any extension of their present installations, or improvement in their machinery, fresh capital would be necessary, and this could only be acquired if the City granted the companies an extension for 25 years of their present privileges. The meeting broke up, says the *Morning*, without a decision being arrived at.

Radcliffe.—Application is to be made to the Local Government Board for a loan for the purchase of land in Dale Street, upon which to erect an electric light station.

Southport.—The Town Council last week decided to adopt the Brighton system of charging for current.

The Electricity Committee wants an electrician in charge, with experience in alternate current work.

Southampton.—Some satisfactory statistics as to the electric light were presented by the committee at the last Council meeting. The engineer reported that the total number of units sold during December was 18,724, being an increase of about 13 per cent. on that for December, 1895. The approximate total number of units sold during 1896 was 121,600, an increase of 21 per cent. on that for 1895.

Stafford.—The baths are to be lighted by electricity, the cost being about £160 for the wiring and fittings, and the annual charge for current from the corporation mains, £40. There will be about 125 lamps of various candle-power, and two arcs outside the buildings. The Public Baths Committee has the matter in hand.

Swansea.—The triple scheme is "up" again. There has now been a poll taken of the town with a view to ascertaining the feeling of the ratepayers, the result being a majority of 886 votes in favour of the scheme. The voting was as follows:—For the Bill, 5,521; against, 4,635.

Train Lighting in Switzerland.—At present 338 carriages on the Jura-Simplon Railway are electrically lighted by means of accumulators. This number is to be increased to 450 during the course of the present year.

Walsall.—The total number of consumers supplied on January 31st last was 76. The total output from the main generators was 17,592 units. The net income for the month was £250 10s. 3d. The wages paid during the month amounted to £45. The value of coal consumed was £30. The Electric Light Committee reports that the accounts for the first complete year's working of the electricity department, being the year ending December 31st last, shows that the total expenditure (exclusive of interest and sinking fund) was £1,130 7s. 9d., and the total income £1,568 7s. 6d., leaving a surplus of £437 19s. 9d. to be applied towards interest and sinking fund, which together amount to £883 3s. 7d., thus making the net total deficiency in respect of the year's working £445 3s. 10d. The electrical engineer has made a report as to a suggested utilisation of the heat from the refuse destructors which the Streets Committee are contemplating providing, for the purpose of generating steam for the electric lighting works, and the matter is to be considered.

Worcester.—A Local Government Board inquiry was held recently to consider the application of the City Council for sanction to borrow £1,338, for the purpose of electric lighting. The work for which the loan is required is the laying of an additional branch main from the generating station at Powick, a distance of 3,436 yards. Mr. Murray, the electrical engineer, explained that the main is required owing to the increased demand for current. It was stated that the total amount previously borrowed for electric lighting in Worcester was £61,766.

West Ham.—The subject of the scandal in connection with the contracts for electric light plant again occupied the attention of this Corporation at its sitting last week. Several of the councillors thought that there should be a Local Government Board inquiry, and eventually it was resolved to ask the Board to conduct a public inquiry. We trust that contractors, if they have been improperly approached in regard to this matter, will freely give evidence, so that the corruption so frequently obtaining in similar affairs may receive a wholesome check, if it cannot be entirely wiped out. Messrs. Ferranti have written to the Corporation, what seems to us, an unnecessarily pungent letter, for we cannot see that their conduct up to the present has been impugned.

Wilts.—The Wilts County Asylum Visiting Committee have resolved upon several extensions and improvements, and these include an electric lighting installation for the asylum.

Yarmouth.—The Borough Surveyor reports that the total number of customers is 204, for 9,976 lamps. The income for the month of January was £413 16s. 8d., whilst £221 7s. 5d. has been earned beyond the cost of production.

York.—The members of the City Council have long been opposed to electric lighting, and so it would seem have many of the citizens. We gave last week an abstract of Prof. Kennedy's recommendations regarding the tenders and the scheme generally. The Council met to discuss the matter, and various motions and amendments were put before the meeting. One resolution was passed, referring the matter back to the committee. Another motion was carried later as a substantive motion, to the effect that the "scheme and tenders propounded by Prof. Kennedy in his report be approved, and that the Streets and Buildings Committee submit to the Council as soon as possible definite plans for carrying out the same."

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Argentine Republic.—A concession has just been granted for the construction and working during a period of 20 years of an electric tramway in the town of Concordia.

Blackburn.—At the half-yearly meeting of the Blackburn Corporation Tramways Company, Limited, the question of the size of cars to be adopted on the Preston Road and Witton routes when the electric system is in operation, was discussed, and a strong feeling was expressed by the meeting that cars to accommodate 50 passengers should be obtained. It was also stated that this point was now under consideration by a sub-committee of the Town Council.

Bristol.—At the half-yearly meeting of the Bristol Tramways Company on Wednesday, reference was, of course, made to the recent controversy with the Corporation of the city in regard to the company's proposals to greatly extend the electrical lines. The chairman, Mr. William Butler, pointed out that their scheme was propounded after the most careful consideration, and after consultation with experts, and although they were prepared in consultation with the Corporation Committee to have accepted any fair and reasonable terms consistent with the safety of the company, they could not, as business men, risk a large capital by placing themselves in the power of a Corporation for the means of making those tramways. They meant what they said when they declared they could not accept conditions which would lead to bankruptcy. The Council had replied, "Oh, well, we will have a Committee to consider the buying up of the tramways," and it was well known that the leader of the movement (Mr. George Pearson) had threatened if the company would not sell by arrangement, that he would "play a little game of his own." The chairman of the company, however, held the belief that Parliament would make short work of an attempt to upset conditions which the city had themselves laid down, fixing the period at the end of which the purchase by the Council could take place. The company was, however, ready at all times to confer with any Corporation Committee, on condition that the terms upon which the company must carry out the work was fair and honourable to the public and shareholders. The company's total revenue for the half-year was the largest ever earned, and a dividend of 6 per cent. per annum was declared.

Cardiff.—The Tramways Committee passed the following resolution at its last meeting:—"That it is desirable, in the interests of the Corporation and the public, that the purchase of the tramways shall be effected, subject to the terms meeting with the approval of the Corporation."

Coventry.—The engineers to the Coventry Electric Tramways, which are proposed to be constructed under the deposited Bill of the present session, have prepared, for the information of Parliament, a detailed estimate of the cost of the proposed lines, which are of an aggregate length of 6 miles 4 furlongs 2 chains, and which will connect with the existing tramways of the Coventry Electric Tramways, Limited. The total cost of the proposed extensions is £47,892, of which £5,350 is for a generating station. These extensions, says the *Financial Times*, are proposed to be constructed by a newly incorporated company with a capital of £105,000, and with power to raise a further sum of £35,000 by the exercise of borrowing powers. This large capital is required in order to provide for a probable purchase of the existing tramways now owned and worked by the Coventry Electric Tramways, Limited.

Crewe.—The Railway Commissioners held an inquiry at Crewe on Wednesday into a proposal by the British Electric Traction Company to construct and work tramways in the borough and district. Objection was taken to the jurisdiction of the Commissioners, on the ground that the scope of their inquiries was limited to the Light Railways Act, and that the present proposal was a tramways scheme pure and simple. The Commissioners granted the order asked for, but promised that the objection should be laid before the Board of Trade.

Dublin.—The introduction of the electric motor system into the Rathmines and Pembroke townships at no distant date now seems, says the *Freeman's Journal*, to be certain, as these townships and the United Tramways Company have practically arranged all disputed points. The company's Bill seeking the necessary powers, so far as these townships are concerned, will be unopposed. But as regards electric traction in the city, the Corporation and the company are still in dissent, the wayleave or mileage rent sought to be imposed being thought much too high by the Tramways Company. The question as to whether electric traction is to be admitted within the city boundaries at all is now in the hands of a special committee of the Corporation, whose decision must soon be made. The journal mentioned believes the Board of Trade has been invoked by the Dublin, Wicklow, and Wexford Railway Company against the Dublin Electric Tramway Company, upon an allegation that their electric cars have been at times run at excess speed. The complaint, it is understood, relates mainly to the past, not the present, working of the electric cars, but having been made has to be inquired into, and it is said that an official inquiry will soon be held in Dublin by the Board of Trade officials.

Electricity for Towing Canal Barges.—An excellent summary is given in the current number of *L'Eclairage Electrique* (apparently derived from Mr. Paul Dupuy's book "La Traction Electrique") of the progress so far made in the direction of electric towage on canals and other navigable inland waters. The results given seem to be based on the experiments made with two different methods on the Bourgogne Canal; the first system consists of an arrangement very similar to that brought out by New and Mayne in this country under the name of "Rudder Motor." The motor in this case is contained in a light detachable metal box forming part of the boat's helm, and works a screw attached to the shaft running at about 300 revolutions per minute. The entire outfit—mounted complete—weighs about 1,800 lbs. In the second method there is employed a three-wheeled electric motor car running on the bank of the canal on a fixed track, and towing the boats along in the usual way by means of a rope. A motorman is in this instance carried on the car, which weighs about 2 tons. Current is in both these instances conveyed to the motors from an overhead wire in the usual fashion. Experiments made first with a barge measuring about 115 feet in length × 16 feet wide, with a tonnage of 186 tons, gave a maximum speed of 2½ kilometres per hour (say, 1½ mile) with the rudder motor and a small screw, this being increased to 3 kilometres (2 miles) with a larger screw. On the return journey (against the wind) a speed between these two was reached, with the sole use of the motor car for towing the barge. A smaller barge of 75 tons measurement was propelled on the first system at a speed of 3⅛ kilometres per hour with the small screw, and 4¼ kilometres with the large one; the same speed (equal to about 2½ miles per hour) being attained by the tow car. Three barges in a string, with a total weight of 418 tons, were also towed by the motor car on the bank at a speed of 2½ kilometres per hour (1½ miles). Further experiments were made last year for the edification of a Belgian Government Commission, and the following figures may be quoted as summarising the results:—

	Tons.		Kilometres per hour.
With rudder motor—			
Weight carried ...	217	Speed reached ...	3⅛
" " ...	170	" " ...	3⅛
With towing car—			
Weight drawn ...	566	Speed reached ...	2 nearly
" " ...	739	" " ...	2 nearly
" " ...	541	" " ...	2

In reporting upon these results, the Commission expressed itself as being very pleased with the ready way in which the barges equipped with the rudder motors answered their helms, and also stated that the towing car ran perfectly well on the bank without excessive side strain. On the whole, this latter method seems to be the better, although it has the decided disadvantage of requiring an attendant to travel on the car, and therefore unable to be of use on the barge. No trouble is experienced with the canal banks from any wash of the rudder motor, and its use leaves the bank free for animal traction or other purposes; but still the tow car seems to give the best results all round. The voltage employed is 300, and for a barge of 200 tons at a speed of 2·7 to 2·8 kilometres per hour about 7 to 8 ampere-hours are required; for a mean speed of, say, 2½ kilometres per hour, the consumption of electricity may be taken to be 1 kilowatt-hour per 100 tons, and at 4d. per kilowatt-hour, the cost per ton kilometre comes out to ·0016 of a penny. These results are considered satisfactory enough to justify a project being elaborated for equipping 242 kilometres of canal, with 30 power houses about 8 kilometres apart from one another, and designed to maintain 60 barges on the canal at the same time.

London.—Major Isaacs, of the Holborn Board of Works, has submitted a special report upon the working of the tramway system in Brussels, Cologne, Hamburg, and Berlin, which cities he has recently visited for the purpose. The board will consider the report shortly.

Leeds.—The Finance Committee has decided to raise a loan of £500,000 to carry out several important schemes, including the cost of the installation of the electric tramways.

Glasgow.—The overhead trolley matter has not been allowed to "lie on the table" long, for the Tramways Committee has decided that all members who have not yet seen the system in operation are to visit Dublin and inspect the working of the lines there. A special meeting of the Committee will afterwards be held to discuss once again the whole question of mechanical traction. The Glasgow Corporation cannot be charged with coming to a decision hastily.

Norwich.—One of the examiners at the House of Commons (Mr. Thoms), after hearing the arguments in respect of the company's electric tramway scheme, decided that, as proposed by the promoters, it constituted a continuous line of tramways, and that the necessary consents to the construction had been obtained. The Bill will, however, have to go before the Standing Orders Committee for consideration of other matters, which the examiner previously decided that the orders had not been complied with.

Praed Street to Willesden Railway.—With regard to this electric railway scheme, to which we referred briefly last week, the *St. James's Gazette* says the proposal is to take the line overhead for a portion of the distance. The total length will be 4½ miles, the line commencing at Irongate Wharf Road, a thoroughfare leading out of Praed Street, near its junction with the Edgware Road. From this point it is proposed to carry it along the towing-path of the Grand Junction Canal, past Paddington Basin, and so on to Carlton Bridge, Westbourne Park, and by the gasworks to Acton Lane, Willesden. For 2½ miles the line, which will have up and down rails of ordinary gauge, will be carried on a viaduct formed of steel columns, 50 to 70 feet apart, supporting lattice girders, the rail level being at an average height of 15 feet above the roadway. Eleven stations will be provided along this short railway, and will afford the facilities which the districts traversed notoriously lack. The cost of this railway is calculated at under £300,000, and the time necessary to start and complete the works at two years.

The Paddington Vestry has decided to strongly oppose the overhead part of the scheme.

Sheffield.—The City Council has adopted the report of its tramway deputation, to which we referred last week, and which recommended the laying down of electric tramways on two sections of the Corporation lines, the overhead trolley system being used. We understand that the committee will at once invite the leading firms to tender for the construction of the lines and the erection of power stations, and if thought necessary, will engage an electrical expert to advise.

The Heilmann System Applied to Navigation.—Much and deservedly criticised as the Heilmann electric system has been in regard to its use on railroads for train propulsion, a still further development of the device has lately been proposed for driving large ocean going ships and vessels, on the plea that greater safety and flexibility are secured in this way than when the main engines drive direct one or two screws only. The idea, however, is not altogether to be credited to the Heilmann interests. A similar proposal was made in the States some time ago, and only the other day we came across another system of the same sort described in an American journal, with about eight or 10 screws to each ship, ranged all around, and each provided with its own electric motor coupled direct and running at a high speed, the advantages claimed being that propeller-racing does not matter, as only one or two out of the large number of screws would at a time be out of the water, whilst accidents to several propellers would not disable the ship. The heavy main screw shafts are done away with, and much energy thereby saved, whilst the main engines operating the big dynamo generators are of the most steady running and economical type, &c. There is not much, we think, to be saved in the average coal bill of a capably-designed and well-engineered marine steam plant, though Atlantic racers are certainly not worked as cheaply as they might be if time were no object. Speaking offhand, it would certainly seem a very desirable thing in some cases to have faster-running screws, such as might be easily arranged with electric motors coupled direct, just as in railroad work there are undoubted advantages in attaching motors to the driving axles; but whether the complication and extra transformations of energy involved by introducing generators and motors would not considerably outweigh any such advantages is, to say the least of it, a very open question.

The Jungfrau Railway.—As doubts are frequently expressed about the realisation of the Jungfrau railway project, we may mention, says a monthly contemporary, that the scientific committee of this undertaking had a meeting last December, in which progress was reported and discussed. The operations on the first section, which reaches an altitude of 7,500 feet, have not been pushed forward as much as was expected, owing to the inclemency of the weather. The men had experienced no trouble from working at this altitude. It will be remembered that general competition was invited. In reply, 48 projects have been submitted, referring to different branches of the problems to be met with, and 16 of these have been awarded premiums amounting altogether to 30,000 francs. The competitors were mostly Swiss or Germans; but we notice among the successful applicants the names of M. Halder, of Pittsburg, who offered a scheme for the electrical arrangements, and of Joseph Bernays, of London, who submitted plans for the lift.

TELEGRAPH AND TELEPHONE NOTES.

Anglo-American Telegraph Company's Cables.—In the *Bullionist* of the 11th inst. we find an article dealing with the above-mentioned company. The following extract, which treats of the present condition of their cables, will be of interest to our readers, to whom we would point out that the new cable laid in 1894, at a cost of £450,000, is of a superior class, and as regards both material and manufacture, must have been more expensive to make than any of its predecessors:—"But by far the most serious matter for consideration is the subject of the fund for the renewal of the precarious properties owned by this company. The capital paid up is £7,000,000, and there have been submerged at one time or other, during the past 30 years, no fewer than eight Atlantic cables. Of these four are now silent and abandoned. The other four were laid respectively in 1873, 1874, 1880 and 1894. Consequently, the cost of each cable at present stands in the company's books at nearly two millions sterling. What is their condition? The report tells us that the company's steamer has been employed during the past half-year 'in the repair of several of the short cables of the company on this and on the other side of the Atlantic, *and of the* "1880" *main cable.*' But apparently no sooner has the latter been repaired in one place, than it has broken in another. For, later on in the report, we read that 'the "1880" cable has again been broken in shallow water near Newfoundland, and will be repaired in the spring.' And similarly at the meeting the chairman made light of the matter: 'The report alludes to the breaking of the "1880" cable,' he said, 'but that is not really a serious matter. It is broken in comparatively shallow water, and there is not the smallest doubt that when fine weather comes round, we shall be able to repair it.' Let it be hoped so; at the same time, when the cable twice becomes silent, whether through actual breakage or old age, or both, within a few months, one would, without the hopeful words of the chairman, at least have imagined there was cause for anxiety, more or less grave. However, it is clear that at present the company's working cables are reduced to three. And this being so, it is important to bear in mind that under the 'pooling' arrangement made in 1873 between the then competing companies, by which the Anglo-American was allotted 48·825 per cent. of the aggregate receipts, there was one important stipulation. It was this: that should the Anglo have at any time thereafter fewer than three cables in working order, the terms of the 'pooling' should be proportionately modified. This was confirmed by the remarks of the chairman at Friday's meeting. 'I hope,' he observed, 'our shareholders will bear in mind that it is all important for us to have three cables in working order. As you probably know, we have to preserve three cables if our proportion of receipts from the "pool" is to be kept up.' 'In view of these breaks,' continued the chairman, 'the directors have very strong opinions with regard to the renewal fund. I have only previously had one opportunity of addressing the shareholders, and that was in 1892. At that time the 1869 cable was in existence, and the renewal fund amounted to about one million sterling. Not very long after that cable failed, and when we attempted to pick it up, it was found in such a condition that we had to spend half of our then renewal fund on making the "1894" cable. At present we have in our renewal fund very little more than sufficient to put down another cable if it was required. The "1869" cable had been down nearly 24 years. We have now two that date back from 1873 and 1874. I do not say that they are going to fail; but in view of the facts, the directors would be very foolish if they did not maintain the renewal fund at least up to its present figure. We ought to be in a very much stronger position as regards the renewal fund than we are at present.'"

Colonial Defence.—An interesting and able paper, entitled "Studies in Australia in 1896," was read on Tuesday last week by the Hon. T. A. Brassey, at a meeting of the Royal Colonial Institute. This gentleman, who is one of the editors of the well known "Brassey's Naval Annual," set before his hearers in the clearest light the position in which the Australian Colonies would stand if, unfortunately, the mother country should become involved in war. The speaker, in referring to the scheme of naval defence, pointed out that during the troublous times last year, it seemed quite possible that we might have found ourselves at war with France and Russia, and although in the immediate vicinity of Australia no great danger was to be feared, owing to the comparative smallness of the naval strength of these powers on the Australian coast, still the fact remained that in the China seas the Russian and French squadrons were equal to, if not superior to, the British squadron. It has been already pointed out in Parliament, that in the event of war, the Russian Government had made preparations to cut the existing cable lines to Australia. It is no secret that this could be easily carried out in the shallow water of the Java seas (and elsewhere), where a glance at a chart shows that half a day's active work of a gunboat would suffice to cut the cables which at present join England with Australia. The experience which the Australian Governments gained a few years back, when, during a period of international tension, all the cables to Australia broke down at the same time, seems not to have been sufficiently impressive. In the alarm which ensued the forts in the Colonial harbours were at once manned, and the Colonial defence vessels were put into full commission. As it afterwards turned out, this alarm was a false one, the sudden and complete cessation of news being only owing to the fact that all the cables to Australia converged at one point in Java, where a local volcanic disturbance had snapped them asunder. An opportunity of avoiding such an occurrence in future, whether due to volcanic forces or effected by an enemy, is now being laid before the Colonial Governments in the shape of the Pacific cable scheme, and we can only hope that this may be appreciated and taken advantage of.

Fifteen Years of Submarine Telegraphy.—An interesting article from the pen of probably one of the oldest members of cable telegraphy, Mr. Geo. G. Ward, appears in the New York *Electrical Engineer* of January 6th. It is natural that he should claim for the North Atlantic the precedence of all in the system of rapid handling of traffic, but at the same time, and perhaps to as great an extent, the methods of rapid signalling by automatic and mechanical means has been as closely worked out on the cables running eastwards, and through enormous traffic-collecting grounds as anywhere else. So far as the service westward is concerned, Mr. Ward claims, and most properly so, that it has been cheapened so far as to eliminate any chance of extravagance being applied to the cost. Facilities have moved and come forward as necessity called, and the connecting of New York City by cable in 1884, thus cutting out dangerous land-line connections, has been amply justified. Mr. Ward states that no cable has been less subject to interference or damage. We find placed on record the feat of a message filed, handed in at Liverpool at 2.59½ in time to transact business before the New York Exchange closed half a minute later, but we recollect 27 years ago getting a Derby result through from the course to the *Times of India* office at Bombay, through all the then number of relays in four minutes. The eventualities of a line "clear" are great. The regular and quick despatch of ordinary traffic are the true factors to gauge the rapidity of a service. The type of instruments vary in different companies to a not very important degree. Duplex automatic transmitters and vibrators are wonderfully alike, but they are all means of improving a service. It is a good record given to us by Mr. Ward of only one error in about 10,000 words, and we recommend the young ladies in our General Post Office to endeavour to make this their standard. The greatest objection to the use of a telephone across the Atlantic, if it were possible, would, Mr. Ward thinks, be a prohibitive price of $75 for five minutes time, *i.e.*, calculating from the present rates over lines in the States—and he thinks the present methods suffice. We think that when a cable has been designed which will have overcome retarding influences, the question of telephonic communication would be solved, and it would, in the same manner as on land, become the means of transmitting thought.

Glasgow Telephones.—The Statute Labour and Telephone Committees of the Glasgow Corporation last week, agreed that on no account whatever should any application for power to lay underground wires be granted to the Telephone Company.

Spanish Telegraphs.—The *Times* correspondent at Madrid says, under date February 10th, that the telegraph system throughout Spain has always been a crying scandal, and instead of improving with the times it gets worse. "The most ordinary atmospheric disturbance is sufficient to render unserviceable the greater part of the lines throughout the country, while a heavy fall of snow or gale of wind generally results in a complete paralysing of the whole service. Under this condition of things it might fairly be expected that the authorities would not place additional difficulties in the way, and that the public convenience would be to some extent considered, but it is not so, and the inefficiency of the office is only on a par with the defective state of the *matériel*. Further, the senseless and useless censorship which is exercised by the Home Office, without the slightest discretion being used as to the nature of the contents of the telegrams detained, results in hours of delay. Two telegrams sent to the *Times* within the last week were detained nine hours before they were despatched."

Telegraphic Communication to the West Indies.—In the House of Commons last week the Chancellor of the Exchequer, in the absence of Mr. Chamberlain, said, in reply to General Lawrie: "I have reason to believe that the Government of Canada are disposed to contribute to the cost of providing direct telegraphic communication between Bermuda and Jamaica, but I am not aware that they have offered a subsidy of £3,000 for that purpose. The Government of Jamaica have expressed their willingness to transfer to a company providing such communication the subsidy of £2,000 a year, which they now pay to the company which now provides telegraphic communication between that colony and the United Kingdom, *viâ* the United States and Cuba and Panama. In dealing with proposals which have been made for the construction and working of a cable between Bermuda and Jamaica, her Majesty's Government have been obliged to take into consideration not only financial questions, but the provision of communication between Jamaica and her Majesty's other West Indian possessions. These questions have presented considerable difficulties, which have not yet been surmounted. I am not aware that the companies to which I understand the hon. and gallant member to refer in his last question have committed themselves to the statements which he attributes to them."

Telegraphic Rates between Great Britain and France.—The British Chamber of Commerce at Paris has proposed that the Sheffield Chamber should communicate to them their opinion of the proposal made by the Paris Chamber, that the charge for telegrams between this country and France should be 1d. per word, with a further charge of ½d., or 5 centimes, until the new cables, which will be necessary in consequence of the increased messages arising from the reduced rates, are paid for. The existing charge is 2d. a word. The secretary has been instructed to convey to the British Chamber that the Sheffield Chamber is entirely in favour of the proposed reduction, as being necessary for the purposes of trade.

The American Pacific Cable.—A Honolulu despatch says that Agent Hartwell has requested the Hawaiian Government to grant a contract in favour of the Pacific Cable Company, having just withdrawn his own application.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1895 ...	...
West Indies—		
Puerto Plata-Martinique	Dec. 19th, 1895 ...	...
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Grenada-Trinidad ...	Feb. 4th, 1897 ...	...
Jamaica-Colon	Feb. 6th, 1897 ...	...
Delay to Trinidad and Demarara 12 to 15 hours.		
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Hong Kong-Macao	Jan. 5th, 1897 ...	...
Pernambuco-Ceará	Feb. 4th, 1897 ...	...
Emden-Vigo	Feb. 10th, 1897 ...	Feb. 15th, 1897.
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Salisbury-Umtali	July 11th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...
Saigon-Bangkok	Feb. 16th, 1897 ...	Feb. 16th, 1897.

Feb. 12th, 1897.—Berne regrets to announce the death of Mr. Rothen, director of the Bureau International des Administrations Télégraphiques.

Interruption to Australian Trunk Landlines at Port Darwin.—From the Australian Press we gather further information regarding the breakdown in the Australian landlines in the neighbourhood of Port Darwin, which interruption lasted from January 8th to 11th last. The immediate cause of the disaster was an earthquake shock, followed by a severe cyclone, lasting four hours. It appears that the Overland Telegraph Company's buildings were badly damaged and flooded, that at Pine Creek the quarters of the telegraph staff there were destroyed, and no accommodation attainable. As far as we can learn, neither of the cables to Port Darwin were interrupted by the earthquake shock, a cause of disaster to them on previous occasions.

Japanese Cable.—We hear the Telegraph Construction and Maintenance Company have received an order from the Japanese Government for 250 miles of submarine cable. Messrs. Clark, Forde and Taylor, will have the superintendence of the manufacture. By the way, it is rumoured that changes are in contemplation in the constitution of the firm of Messrs. Clark, Forde & Taylor, as heretofore carried on, owing to the retirement of some of its members.

Reduction in Telegraph Rates to the Far East.—The following extract from the *Hong Kong Telegraph* points to the possible reason for the reduction of rates in the Far East:—"We have much pleasure in directing attention to the revised tariff of the United Cable Companies as published in our advertising columns in this issue, and which comes in force on January 1st, 1897. The new tariff shows a decided reduction of rates, and indicates, we take it, that common sense and a desire to show consideration for Far Eastern supporters have prevailed over the selfishness of shareholders in high places. They seem to have at last arrived at the conclusion that their position was not absolutely impregnable, and that the Pacific cable scheme might materialise in a manner that would prove very disastrous to their vested interests. We are constrained to admit, however, that this revised tariff shows that the needs of the mercantile communities of the Far East have at length been met in a fairly liberal manner. But while expressing our thanks for small mercies, it is nevertheless our duty to remind our readers that the danger in the situation has not been lessened in the smallest degree since the commencement of the comparatively recent agitation, for there is no promise or guarantee that the new rates will remain in force for any specific period of time, or that we shall not again be subjected to the inconvenience of another sudden and monstrous increase in rates."

Telegraphs in Nyassaland.—Reuter's agent at Blantyre says that on Saturday, December 26th, another section of the African trans-Continental Telegraph Company's line was opened, a branch section—that between Chiromo and Chikwawa. This new piece fills in the blank which hitherto existed in the direct line of communication between the east coast of Africa and Zomba. There is now an uninterrupted line from Chinde and Quelimane and the east coast to Zomba. Owing to the delay caused by the troubles in Mashonaland, there does not appear to be much prospect of the line from Salisbury to Tete being completed during the present year. British Central Africa is still, therefore, without telegraphic communication with Europe, as the Eastern Telegraph Company's cable does not touch at Quelimane or Chinde.

Trunk Telephones.—In the House of Commons, on 12th inst., Mr. Hanbury, replying to Mr. Asher, said the Postmaster-General was not proposing to abandon the scheme of carrying the trunk telephone lines from Aberdeen to Elgin through Peterhead and Banff. The engineers of the Post Office proposed to carry the line by a shorter and more direct route, but the Postmaster-General had decided to adhere to the route originally selected.

CONTRACTS OPEN AND CLOSED.

OPEN.

Ashton-under-Lyne.—March 15th. The Corporation want tenders for the supply and erection of refuse destructors, boilers, dynamos, transformers, cables, lamps, accumulators, &c. Consulting engineers, Fawcus & Clirehugh, Temple Chambers, Brazennose Street, Manchester.

Bray (Ireland).—February 22nd. The Town Commissioners invite tenders for the extension of the switchboard at the electric light station. Particulars, &c., from the Town Clerk (Mr. P. McDonnell), at the Town Hall, on deposit of £1.

France.—February 27th. The Seine Prefectural Authorities in Paris are inviting tenders for the concession for the electric lighting of the Broca Hospital during a period of 10 years. Tenders to the Prefet de la Seine, Tribunal de Commerce, Paris.

France.—March 4th. The French Post and Telegraph Authorities in Paris are inviting tenders for the supply of 235 tons of copper wire in nine lots. Tenders to be sent to the Sous Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

France.—March 9th. Tenders are being invited by the French Post and Telegraph Authorities in Paris for the supply of 122 kilometres of paper-insulated electric cables, in two lots. Tenders to be sent to the Sous Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

France.—March 10th. Tenders are being invited for the contract for an installation of electric lighting in the Asile Departemental d'Aliénés du Rhône, at Bron. Tenders to be addressed to the Préfecture du Rhône, Lyons.

Germany.—February 20th. Tenders are being invited by the Altona Direction of the Prussian State Railways for the supply of 4,000 incandescent lamps and 179,000 arc lamp carbons required during the financial year 1897-98. Tenders to the Königliche Eisenbahn Direction, Altona.

Glasgow.—February 24th. The Corporation want tenders for the supply and erection of two large storage batteries. Electrical engineer, Mr. Arnot, 75, Waterloo Street. See our "Official Notices" for further details.

Islington.—The Vestry are inviting tenders for a year for the supply of various stores, &c. Item (11) is for the supply of manhole and other covers, &c., and ironwork; (14), supply of iron, steel and tools; (19), supply of electrical stores; (20), supply of engineer's stores. Further particulars may be obtained at the Vestry Hall, Upper Street, N., between 10 a.m. and 12 noon.

Jamaica.—April 15th. The Privy Council invites applications for a license for the establishment and working of a system of rapid transit in Kingston and environs. Copies of the Tramways Law, 1895, and of local rules and maps of Kingston and environs may be seen at the offices of the Crown Agents for the Colonies, London.

Morecambe.—The District Council is inviting tenders for the supply and erection of boilers, dynamos, mains, transformers, accumulators, arc lamps and posts, testing apparatus, &c. See our "Official Notices" for further details.

Roumania.—March 15th. The Municipal Authorities of Braila, Roumania, are inviting tenders for the concession to construct and work during a period of 35 years, of a system of electric tramways in the town. Tenders may be submitted for either the accumulator, electro-magnetic, or overhead-conductor systems of traction. Particulars from and tenders to La Mairie, Braila, Roumania.

Spain.—February 23rd. Tenders are being invited by the Municipal Authorities of Tarragona for the concession for the electric lighting of the town during a period of 20 years. Tenders to be sent to El Secretario del Ayuntamiento de Tarragona.

Spain.—February 26th. Tenders are being invited by the Municipal Authorities of Villada (Palencia province) for the concession for the electric lighting of the town during a period of 16 years. Tenders to be sent to El Secretario del Ayuntamiento de Villada (Palencia province).

St. Pancras.—February 23rd. The Vestry want tenders for the supply and erection at King's Road Electricity Works, of two Lancashire boilers, feed pumps, steam pipes and accessories. Particulars obtainable at Electricity Department Offices, 57, Pratt Street, N.W. See our "Official Notices."

West Ham.—February 24th. The Corporation invite suggestions for free-wiring of premises in streets about to be provided with mains for the supply of electric light. Particulars from the electrical engineer, Mr. J. J. Steinitz, at the Town Hall, West Ham, E

CLOSED.

Dewsbury.—The tender of Messrs. Callender's Cable and Construction Company for electric lighting cable for New Bridge Street (at £105 odd), has been accepted by the Council.

Hastings.—The Public Lighting Committee require certain modifications made in the construction of the two boilers which were ordered from Messrs. Babcock & Wilcox, Limited, and these the company has agreed to at an additional charge of £30, making the total £884.

Southampton.—The Council has renewed its contract for supply of coal to the electric light station with Messrs. G. T. Harper & Son.

NOTES.

Dust Destruction.—Mr. R. W. Richards, J.P., the City Surveyor of Sydney, is now in this country for the purpose of inquiring into refuse destruction, electric lighting, and other matters of interest to the municipal authority of Sydney. From this country he is to proceed to Paris, Berlin, and Vienna. Mr. Richards is a celebrated official in Australia, and is being well received on this side. We hope his visit will result in some good business for English manufacturers.

Personal.—We understand that Mr. Rollo Appleyard has been appointed reporter to the Physical Society, a matter in which the society is to be congratulated. Mr. Appleyard's abstracts of articles of scientific interest have for several years appeared in the *Journal* of that Society.

A Method of Measuring the Temperature of Incandescent Lamps.—This method of measuring the temperature in incandescent lamps is the result of a research by P. Janet, which we noticed some time ago. He now describes the method in the *Comptes Rendu*, Vol. cxxiii., pages 690 to 691. The resistance of the filament of a lamp varies greatly with its temperature. Suppose a difference of potential varying from O to E to be applied to the terminals of the lamp; for every value of E the temperature will take a value θ, and the resistance a value R. Let the current be stopped at the time O, and, as it cools, let the variation of the resistance of the filament be studied as a function of the time. Construct a curve (B), having for abscissæ the times, and for ordinates the resistance, R. By means of curve, A, we can deduce a third curve, C, having for abscissæ the times, and for ordinates the power lost by radiation at each instant. The area of this curve gives the total energy lost by radiation from the maximum temperature of the filament down to the ordinary temperature. Dividing by the mechanical equivalent of heat we get the amount of heat which corresponds to this. Finally, if we weigh the filament and assume that certain data are known, we can deduce the temperature. The method enables us to investigate the variation of the resistance of the filament with temperature, and the variation of the radiation with temperature. The data required have been supplied by Violle's determinations of the mean specific heat of carbon from 0° to temperatures above 1,000°. The above method further involves the assumption that the filament consists of pure carbon.

New Journal.—The latest addition to the list of American electrical journals is the *Electro-Therapeutist*, a monthly pamphlet of about fourteen pages.

Air Space Cables.—After the lecture, "Sixty Years of Submarine Telegraphy," to which we refer in another place, there might have been seen a show case from the Telegraph Construction and Maintenance Company, containing various specimens of cables, amongst them a particularly interesting form with a hollow tube-like core. The sketch shows a section of the cable, the air space in the middle being for the purpose of securing lower inductive capacity between

wire and wire. We cannot give the exact difference in capacity between solid cored conductors and the air space form, but we are informed that inductive troubles are very materially lessened in the new type of core. The patent under which this is made is No. 8,573 of 1895, granted to Willoughby Smith and Granville. Some miles, we understand, are now in course of manufacture for Mr. Preece for G.P.O. purposes. What the effect of water pressure, at considerable depths would be, upon such a core, we are not prepared to say.

Municipal Electrical Association.—We have received a copy of the official proceedings of the Municipal Electrical Association for the year 1896. Copies may be obtained upon application to Mr. A. B. Mountain, honorary secretary, electrical supply station, Huddersfield. Price (including postage) 3s. 8d.

A Great Gun Magnet.—Mr. W. R. King writes to the *Electrical Review*, N.Y., giving the worked-up results of experiments made in June, 1895, with a gigantic electro-magnet, consisting of a 15-inch cast-iron gun weighing 50,000 lbs., and wound with about 10 miles of insulated wire. The strength of the magnetic field in the prolongation of the axis of the magnet was tested by placing small compasses at equal intervals along the line, and noting the deflections. At a distance of 74 feet from the gun the strength of the field was equal to the horizontal component of the earth's magnetism In one of the experiments two 15-inch guns, each wound with four miles of wire, were placed side by side, and yoked together by a pile of railway bars, making, thus, a large horse-shoe electro-magnet. To ascertain whether the strength of the magnetic field per square inch was greater than that of other magnets, an experiment was made on the lifting power of the magnet. The pull required to separate the end of the armature from the gun was 22,400 lbs., or about 400 lbs. per square inch of contact. The entire pull on the armature was 44,800 lbs. To compare this with other record magnetic fields, Mr. King cites the best results obtained by Joule, Rowland, Bidwell and Ewing. Joule obtained a lifting force of 200 lbs. per square inch. Rowland's opinion was that 175 lbs. per square inch was about the maximum obtainable with an electro-magnet. Bidwell, however, obtained as high a pull as 226 lbs. per square inch; and finally Ewing, by a special method of concentrating the force on a very small area, is said to have greatly increased these figures. The pull obtained by King corresponds to 170,000 lines of force per square inch.

Congratulations!—From the *Court Circular*, we observe that the Prince of Wales, President of the Society of Arts, presented to Prof. D. E. Hughes, F.R.S., at Marlborough House, on Tuesday, the Albert Medal awarded him by the Council of the Society "in recognition of the services he has rendered to Arts, Manufactures, and Commerce by his numerous inventions in electricity and magnetism, especially the printing telegraph and microphone." The following members of the Council were present:—Major-General Sir Owen T. Burne (chairman), Mr. J. Wolfe Barry, Sir George Birdwood, Viscount Cross, Mr. Joseph G. Gordon, Sir Charles M. Kennedy, Sir Stuart Knill, Mr. W. H. Preece, Sir Owen Roberts, Prof. Roberts-Austen, Sir Saul Samuel, and Mr. A. Siemens, with Sir Henry Trueman Wood, secretary, and Mr. Henry B. Wheatley, assistant secretary.

Marriage.—We learn that on the 11th inst., at the Wesleyan Church at Higher Broughton, Mr. E. H. Ingram, late resident engineer at the Coatbridge electric light station, was married to Miss Evelyn Roberta James. Shortly before his marriage Mr. Ingram obtained the appointment of station superintendent at the Madrid station of the Electricity Supply Company of Spain, and the newly married couple proceeded to Madrid immediately after the wedding. Mr. Ingram has our congratulations and good wishes.

Imitation the Sincerest Flattery.—We are informed that a number of Welsbach burners, used for lighting Donegal Street, Belfast, are being replaced by Bray burners, which are said to give a far better light, though they probably use more gas. On the other hand, our correspondent notes that during the past week a very handsome fitting (at night) has been fixed in the centre of Castle Junction, consisting of five "imitation arc lamp fittings," each containing three Welsbach burners.

Society of Arts.—On Wednesday evening, February 17th, a paper on "Light Railways" was read by Everard R. Calthrop, Esq. The chair was taken by the Attorney-General, G.C.M.G., Q.C., M.P.

An Exact Method for Estimating the Intensity of the X Rays.—At a recent meeting of the Yorkshire section of the Society of Chemical Industry, F. W. Branson communicated an interesting paper on an exact method for estimating the intensity of the X rays. For comparing different sources of the X rays, the hand placed upon an ordinary fluorescent screen of barium-platino-cyanide is a convenient test; but if an exact record is desired, a photographic process is necessary. The following method seems quite free from error:—A quadrant of aluminium is taken, with millimetre steps (1-10). This is superimposed on a photographic plate, which is enclosed in a light tight envelope, a vacuum tube is placed at a standard distance from the sensitive film, and an exposure of definite duration is given. Development with a standard developer at a temperature of 60° F. for five minutes will reveal a number of steps on the negative, that number being exactly proportionate to the intensity of the X rays. Comparative tests can thus be made with different vacuum tubes, or with the same tube under different conditions. Mr. Branson then demonstrated the production and properties of the Röntgen rays by means of various apparatus, including the Wimshurst electrical machine, and exhibited a large number of photographs taken by these rays. In answer to an inquiry as to whether any photographs had been taken by means of the Wimshurst machine, Mr. Branson stated that it was quite practicable, but that the time of exposure necessary was much greater than with a good induction coil, the minimum with the machine exhibited being about 20 minutes, whilst one minute sufficed with a coil which gave a 10-inch spark. This was accounted for by the great difference in intensity, which might be overcome by increasing the number of plates, and consequently the quantity of the discharge. Mr. Branson considered that the use of the Wimshurst machine as a means of generating the X rays was capable of application to many commercial enterprises, on account of its simplicity and adaptability to driving by mechanical means.

An Electric Locomotive in a Railway Yard.—For the purpose of shunting cars at New Haven from the main line along the road, which appears to be the joint property of a number of manufacturers, an electric locomotive has replaced horses. The road is only two miles long, and the General Electric Company (U.S.) have furnished for this purpose a 30-ton locomotive, and this has been at work since December 11th last. The draw-pull is 7,000 lbs. There are four wheels of 44 inches diameter. The voltage is 500, and the current 600 amperes at full and 300 at half speed, with normal drawbar pull. The overall dimensions are 16 feet 6 inches × 11 feet 6 inches × 8 feet 3 inches, and the wheel base 5 feet 6 inches. There is a motor to each axle. They are gearless, and supported on spiral springs. The trolley system is worked. The armatures are of ironclad type, and are wound on a sleeve through which the axle passes, motion being communicated by projecting arms and a plate to form a flexible coupling. The usual fittings are provided.

Birkbeck Institution.—The students of the Birkbeck Literary and Scientific Institution held their first annual conversazione at Bream's Buildings, Chancery Lane, on Saturday last. The guests, who numbered about 1,350 to 1,400 were received by Mr. Justice Gainsford Bruce, Vice-President of the Institution, who was supported by Mr. G. Armitage-Smith, the Principal, and members of the Council. We notified in our issue of the 5th inst. particulars of the entertainments, lectures, and exhibits, electricity being well to the fore, and we are glad to think that the ready assistance given by the Postmaster-General, through Mr. W. H. Preece, with working telegraph circuits, Mr. Lynd with the Edison-Bell phonograph, Mr. Wimshurst with his influence machine, the National Telephone and Electrophone Companies in bringing to the ears of the audience a variety of entertainments carried on in places of amusement in the metropolis, and the Electrical Power Storage Company, in providing a set of secondary batteries for the arc light projectors, did very much towards making the meeting an unqualified success. The secretaries of the Entertainment Committees rendered yeoman service, and the results of their labours must have been particularly gratifying.

The Electro-Harmonic Society.—The last ladies' night of the present season takes place next Friday evening. The programme we, as usual, give in our supplement, and surely, with excellent vocalists, mandoline, guitar and violoncello soli, recitations by the well-known Mr. Ernest Meads, and humorous sketches by Mr. Roland Henry, who pleased so much at the last "Smoker," all tastes will be gratified.

Magnetism and Light.—Zeeman, of Amsterdam, has recently discovered a curious influence exercised by the magnetic field upon the period of light emitted by a flame. He introduced into an oxyhydrogen flame, placed between the poles of a Ruhmkorff's electro-magnet, a filament of asbestos soaked in common salt. The light of the flame was examined with a Rowland's grating. Whenever the circuit was closed, both D lines were seen to widen. To eliminate possible sources of error in this experiment, another experiment was made by heating sodium strongly in a tube of biscuit porcelain, closed at both ends by plane parallel glass plates. The tube was placed horizontally between the poles of the magnet, at right angles to the lines of force. The light of an arc lamp was sent through. The absorption spectrum showed both D lines. Excitation of the magnet caused immediate widening of the lines. It thus appears very probable that the period of sodium light is altered in the magnetic field. Zeeman considers that the true explanation of these results is afforded by the theory of electrical phenomena propounded by Prof. Lorentz. According to this theory, there are in all bodies small molecular elements charged with electricity, and all electrical processes are to be referred to the equilibrium or motion of these "ions." Zeeman considers that in the magnetic field the forces directly acting upon the ions suffice for the explanation of the phenomena. Prof. Lorentz, when consulted on this subject, predicted that the light from the edges of the widened lines would be found to be circularly polarised when looked at in the direction of the lines of force; and further, that the magnitude of the effect would lead to the determination of the ratio of the electric charge which the ion carries to its mass. These predictions were verified by experiment. [See *Proc.* Physical Society, Berlin, and *Nature*, February 11th, 1896.]

Lectures.—Mr. H. A. Mavor lectured on "Electrical Machinery," before the Glasgow students' branch of the Institution of Civil Engineers, on 8th inst.

Before the Llanelly Chamber of Commerce, on 12th inst., Mr. J. C. Howell lectured on "The Electric Lighting of Llanelly," explaining the scheme which he had offered to the Borough Council for the lighting of the main streets of the town.

Internal Rays.—Prof. S. P. Thompson, in a letter to *L'Eclairage Electrique*, explains the distinctive properties of a new kind of rays, which he has discovered inside the X ray tube, and which he calls "internal rays." These rays, which we have already shortly described in our report of the British Association meeting at Liverpool, differ from the Röntgen rays in being deflectable by a magnet, and from the cathode rays in being given off in every direction from the surface of the anti-cathode. Prof. Thompson's attention was first drawn to these rays by observing that the boundary line of the fluorescence in a focus tube was displaced by a magnet, while no displacement of the corresponding line on a fluorescent screen held outside the tube, was observed. Evidently, then, there were some deflectable rays flowing along with the Röntgen rays inside the tube, but unable to pass with the latter through the glass. These rays do not appear to us to be so different in kind from the Röntgen rays as to require to be characterised by a special name. If Lenard's theory of the difference between the cathode and the Röntgen rays be correct, the two kinds of rays regarded from the point of view of magnetic deflectability pass into each other by insensible gradations. Though Prof. Thompson says internal rays do not pass through glass, they may be able to pass through the sides of an aluminium tube, in which case they would merely be a variety of our old friends the Lenard rays. There appears to have been a great tendency lately among X radiationists to mistake mere varieties for new species.

The Institution of Electrical Engineers.—The following is the programme for next week's meeting (February 25th):—"Electric Interlocking the Block and Mechanical Signals on Railways," reply of Mr. F. T. Hollins to the discussion; "Relative Size, Weight, and Price of Dynamo-Electric Machines," paper by E. Wilson, member.

NEW COMPANIES REGISTERED.

London Motor Van and Wagon Company, Limited (51,306).—Registered February 10th with capital £300,000, in £5 shares, to adopt an agreement with the New Traffic Syndicate, Limited, and to carry on the business of proprietors of vans, wagons, carriages, and other vehicles, jobmasters, carriers, builders of vehicles, carpenters, joiners, electricians, engineers, machinists, rubber merchants, &c. The subscribers (with one share each) are: H. F. Garrett, 54, Gloucester Street, Bloomsbury, clerk; F. H. Riches, Shenley Road, Camberwell, S.E., clerk; H. Paul, 14, Brailsford Road, Tulse Hill, S.W., gentleman; J. W. Honess, 22, Caistor Road, Balham, S.W., gentleman; E. T. Church, 41, Copleston Road, Denmark Park, clerk; A. Eldridge, 30, Buttisland Street, N., accountant; A. W. Lawson, 338, Romford Road, Forest Gate, clerk. The number of directors is not to be less than three nor more than 10. The subscribers are to appoint the first; qualification, £250; remuneration, £200 each per annum, or 10 per cent. of the net profits divided. Registered by Ashurst & Co., 17, Throgmorton Avenue, E.C.

National Gas Engine Company, Limited (51,235).—Registered February 12th with capital £50,000, in 320 ordinary and 180 £5 per cent. preference shares of £100 each, to acquire and carry on the business of a gas and oil engine manufacturer, electric plant manufacturer, gas works plant manufacturer, millwright, engineer, tool maker, &c., carried on by H. N. Bickerton as "The National Gas Engine Company," at Ashton-under-Lyne and elsewhere, and to acquire certain patents. The subscribers (with one share each) are: H. Prescott, 1, Hamburg Terrace, Stretford, engineer; F. H. Orme 147, Windsor Road, Oldham, engineer; J. Bickerton, Ingleside, Altrincham, engineer; W. H. Deane, Heyside, near Oldham, mill manager; H. Gartside, Early Bank, Stalybridge, brewer; H. W. Bradley, Lonsdale Road, Fallowfields, Manchester, engineer; H. N. Bickerton, 6, Richmond Street, Ashton-under-Lyne, engineer. The number of directors is not to be less than two, nor more than seven; the first are the first five subscribers. Qualification 10 shares. H. N. Bickerton is the managing director, with £300 per annum. Registered by C. H. Hodges, 12, New Court, Carey Street, W.C.

Mauritius Gas and Electric Lighting Corporation, Limited (51,249).—Registered February 13th with capital £50,000, in £1 shares, to acquire gas, coal, and electric light works at Port Louis, in Mauritius, to manufacture, sell, and supply light in the said island and elsewhere, and to carry on the business of gas and electrical engineers, stove manufacturers and electricians, &c. The subscribers (with one share each) are: A. E. W. Boughton, 8, Dunollie Road, Lady Margaret Road, N.W., secretary; P. J. Rawlings, 22, Hemingford Road, Barnsbury, N., clerk; W. O. Wand, Bolton Road, Chiswick, W., printer; J. Rawlings, 30, Stroud Road, Woodside, S.E., draughtsman; W. J. Dowdall, 1, Mimosa Street, Fulham Road, S.W., stationer; F. J. Powell, St. Aubins, Aubins Road, Croydon, accountant; W. Meads, 32, Amwell Street, E.C., journalist. The number of directors is not to be less than three, nor more than seven. The subscribers are to appoint the first; qualification, £100; remuneration, £350 per annum and a share in the profits divided. Registered by Gover & Chiles, 71, Queen Street, E.C.

CITY NOTES.

Dividends. The dividend announcements hitherto made must be considered very satisfactory. We append some of the principal in the order published:—

	1895. Per cent.	1896. Per cent.	Increase Per cent.
City and South London Railway Company	$1\frac{2}{16}$	$1\frac{2}{16}$	$\frac{0}{0}$
Liverpool Overhead Railway	$2\frac{7}{8}$	$2\frac{7}{8}$	...
St. James's and Pall Mall Electric Lighting Company	$7\frac{1}{4}$	$10\frac{1}{2}$	$3\frac{1}{4}$
Cambridge Electric Supply Company ...	$3\frac{1}{2}$	5	$1\frac{1}{2}$
Yorkshire House-to-House Company ...	5	6	1
Coventry Electric Tramways	...	8	...
Westminster Electric Supply Company ...	7	9	2
Newcastle and District Electric Lighting Company	...	7	...
National Electric Supply Company	...	$2\frac{1}{2}$	...
W. T. Henley's Telegraph Works Company	8	10	2
Telegraphic Construction and Maintenance Company	15	15	...
Kensington and Knightsbridge Electric Lighting Company...	6	7	1
Charing Cross and Strand Electric Lighting Company	5	6	1
City of London Electric Lighting Company	5	7	2

Cuba Submarine Telegraph Company, Limited.

This company held its half-yearly meeting on Wednesday at 58, Old Broad Street.

Mr. C. W. Parish, who presided, said that the record of the working for the six months ended December, 1896, was satisfactory, the receipts for the whole of 1896 having amounted to the highest figure ever reached in any year by the company. They earned £54,116 in 1895, and £58,635 in 1896. During the latter year they had had the benefit of the Cienfuegos-Manzanillo cable, which somewhat accounted for the increased receipts. The expenditure to earn the money in the last six months amounted to £7,180, compared with £5,539 in the corresponding six months of 1895, the whole of this increase being explained by the cost of working the stations, especially the new ones in connection with the Cienfuegos-Manzanillo cable. The company had subscribed £100 to the Humanitarian Spanish Relief Fund. The result of the six months' working enabled them to pay the same rate of dividend that had been paid of late, viz., 10 per cent. upon the preference shares, and 8 per cent. on the ordinary shares, besides placing £11,000 to the reserve fund. All must feel that that was a very satisfactory state of affairs. As to the breakdown of the Cienfuegos-Santiago cable in 1881, he would remind the meeting that this was not a new cable when it was laid. It had done the company most excellent service, and although, unfortunately, he believed the break was in deep water, he had every hope that Mr. Keith would be able to continue the cable's life, either by laying a new length or by some other combination. At the last meeting he referred to different schemes for laying fresh cables, some of which would approach the Cuba Company's waters. Since then a cable had been made connecting New York and Hayti, joining into the French system at Guadeloupe and Martinique, and then on to South America. The traffic from the French system, which had up to the present come to the Cuba Company at Santiago, would, he feared, in future go over the new cable to New York. It was almost impossible to forecast what reduction this would cause in the Cuba Company's receipts, but he thought it only fair that he should warn the shareholders that it might be very considerable.

Mr. Keith seconded the adoption of the report, which was agreed to, and the dividends were declared on the motion of the chairman, seconded by Mr. R. Kaye Gray.

An extraordinary general meeting was immediately held for the purpose of passing a special resolution, of which the directors had given notice, altering the articles of association. After discussion, the following article, which differs somewhat from the form originally proposed by the board, was adopted with one dissentient:—

"The directors may appoint Mr. Keith, a member of the board, to the post of engineer, or to any other office in the service of the company, and either for a fixed term or otherwise, and may from time to time remove or dismiss him from such office. The powers and duties of Mr. Keith as such engineer or other officer, and also his remuneration, shall be defined and fixed by the directors from time to time, and such remuneration may be either inclusive or exclusive of his fees as director. Also, if any director be required to go abroad, or render any other extraordinary service, the directors may grant him such special remuneration for the service rendered as they may think fit. Mr. Keith shall not be under any disqualification by reason of his holding any office in pursuance of this regulation, which is hereby declared to be retrospective."

Votes of thanks to the chairman and directors closed the meeting.

The India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited.

The directors' report for the year ending December 31st, 1896, to be presented at the thirty-third ordinary general meeting of the shareholders, to be held at the Cannon Street Hotel, London, on Thursday, February 25th, 1897, at 12 o'clock noon, states that, after provision for doubtful debts, there remains a net profit for the past year of £51,888 17s. Adding £20,239 9s. 4d. brought forward, and deducting £12,500 interim dividend paid in July, there remains a disposable balance of £59,628 6s. 4d. The directors recommend the distribution of a dividend of 15s. a share, free of income tax, amounting to £37,500, making, with the interim dividend paid in July, a total payment of 10 per cent. for the year, and leaving £22,128 6s. 4d. to be carried forward. The year's general business has steadily increased, but the cable department and steamships have again been only moderately employed. The factories at Silvertown and Persan are in a high state of efficiency. The company's debenture issue was carried out last year, and now stands at £300,000 bearing 4 per cent. interest. The death of Mr. W. J. Tyler in November last, after 25 years' service, was deeply regretted by the directors, and will be felt by all the shareholders. Major Leonard Darwin (late R.E.) joined the board in July last.

National Telephone Company, Limited.

At the half-yearly meeting, yesterday, at Cannon Street Hotel, Mr. J. Staats Forbes, in his usual interesting manner, addressed the shareholders on the state of the company's affairs during the past six months. The income accrued for the half-year, he stated, was £17,328 more than for the same half-year of 1895. The expenses were £28,741 more. The profit balance was £154,982, or a decrease of £12,891; but during the 1895 half-year the company had possession of the trunk lines, which had since been taken over by the Post Office authorities, who had in consequence taken the revenue from those lines, which formerly amounted to about £40,000 per half-year. There had been a very marked increase in the expansion of wires. In the last half-year, as compared with the corresponding period, they had 6,457 more wires, which compared with an increase

of 4,483. The increase in wires erected had been 12,314 compared with 8,740. With regard to the promises put forward by some people that they would erect telephones in various places at £5, £10, or £20, he would mention that the new connections made by this company last half-year cost £39 odd each; 12,000 times that amount meant a large sum. They were improving the efficiency of the service. In London, for instance, they were changing to the metallic circuit, or twin wire system, at great cost. In referring to the accounts, he drew attention to the item unexpired terms, £414,714. which compared with £354,000 in 1895, an increase of £60,078. This increase, he said, gave some idea of the expansion of the business. Although they had had a drawback in the loss of the trunk revenue, yet they would reap great advantage from the extension of the trunk system by the P.O., and, in addition, they had £458,000 in their pockets receiving interest, which was the sum the P.O. paid for the lines. Without prophesying, he thought there was every promise of the current half-year's dividend being the same as the last half of 1896. After treating with general matters, Mr. Forbes moved the adoption of the report, which was seconded by Sir James Fergusson, and carried.

A Shareholder asked whether any sums were paid by the company for the power of using condensers in the telephone circuits, and the Chief Engineer replied in the negative.

Mr. J. E. Kingsbury asked whether, in the event of the company being wound up, the third preference shareholders would participate in the surplus assets.

The Chairman replied that the question was a debatable one. They had taken advice upon the point, and this was that they will participate with the other ordinary shareholders in any surplus assets in proportion to their holdings. He did not see how it was a question to be raised until the company was wound up.

Votes of thanks to the board and staff closed the meeting.

Newcastle and District Electric Lighting Company, Limited.

The annual meeting of the shareholders of this company was held last week at Newcastle. Mr. J. D. Milburn (chairman) presided.

The Chairman, in moving the adoption of the report and the declaration of a dividend as recommended, said it had afforded the directors very much pleasure to be able to increase the dividend. Seven per cent. was a very good interest on money. He did not know whether they should be able to increase it still further, but every attention was shown to the management of the company with a view to increase the business. They had extended westward almost to the utmost limits of the borough boundary, beyond which they could not go without some special permission, which might be difficult to get. They had been rather disappointed in the amount of energy demanded by Elswick Road, Westgate Road, and Arthur's Hill, but they were now thinking of pushing along Scotswood Road, and hoped to secure additional customers there. Last year they mentioned that they had one or two undertakings in hand, and amongst those was the lighting of Gateshead. They were called the Newcastle and District Company, and from the beginning it had been in their minds that they might light Gateshead. For that reason probably, amongst others, they secured their present station at Forth Banks, where they could very easily get across the river. Unfortunately, the Gateshead people did not seem to want the light. They did not seem to want anybody to produce it, nor to set about producing it themselves. Therefore that matter was at present in abeyance. There was a mistaken notion among consumers that to keep a lamp hanging as long as possible and to wear it out was economical. He thought it would be found that if lamps were removed after they had been used for two or three months and new ones substituted, a much better light would be the result. Every possible care had been taken to keep the mains dry, and for that reason they had had no accident and no trouble.

Sir Benjamin Browne seconded the motion, which was carried.

The National Electric Supply Company, Limited.

The ordinary general meeting of the members of the above company was held last Wednesday week at Preston.

The Chairman reported that since the issue of the report and accounts to the shareholders, certain suggestions had been made by the Board of Trade, and the directors now recommended that the meeting be adjourned in order to fully inquire into those suggestions, and, if possible, to give effect to the same.—Resolved accordingly.

The retiring director, Mr. H. Curwen, was unanimously re-elected.

The auditors, Messrs. T. Thorp and Ainsworth, were also re-elected.

Thanks to the chairman and directors terminated the meeting.

The Charing Cross and Strand Electricity Supply Corporation, Limited.

In submitting the accounts for the year ended December 31st, 1896, the directors are pleased to state that the business of the company continues to show a most satisfactory increase. The directors have to announce with the deepest regret the death of Mr. Agostino Gatti, one of the managing directors. Mr. John M. Gatti, his eldest son, has been elected a director in his place. The Bill confirming the provisional order enabling the corporation to supply electricity in the district of the Strand Board of Works, received the royal assent. Judging by the results already obtained, the directors have reason to congratulate the shareholders on obtaining the increase of their powers. The new central building covers a space of about 10,000 superficial feet, and is erected and equipped in the most modern and approved manner. An extensive electrical plant, capable of supplying energy to 80,000 8-C.P. lamps, has been designed and erected under the superintendence of the chief engineer, and further plant, for which there is ample space, will be erected as required. Trunk mains have been laid connecting the two stations, and a large supply of energy is now being taken from the new station. Five miles have been added to the mains already laid in St. Martin's Parish, and 41 miles of mains of sufficient capacity for 85,000 8-C.P. lamps have been laid in the Strand district. The entire network of mains in that district is now nearly completed. The efficiency of the station has been well maintained, the plant, machinery, and mains working in a most satisfactory manner. The demand for current, both in the St. Martin's Parish and the area of the Strand District Board of Works, has considerably exceeded expectation, and the number of lamps to which the company was supplying energy on December 31st, 1896, was 73,464, or an increase of 22,164 8-C.P. lamps over those supplied in the year 1895; these totals include 12,641 8-C P. lamps connected in the Strand District, although the corporation only commenced to supply electrical energy there in August last. The directors are proposing to take immediate steps for issuing the remaining £50,000 of preference share capital. The net earnings, as shown in the revenue account, have amounted to £15,288 15s. 1d.; £622 12s., balance of law costs suspense account, has been written off; £3,579 11s. 6d. has been paid in respect of interest on debentures and temporary loans up to December 31st, 1896; and £3,625 was distributed in payment of an interim dividend at the rate of 5 per cent. for the half-year ended June 30th, 1896. A sum of £7,461 11s. 7d. remains, which, added to the undivided profit of £1,397 6s. from last year's account, makes £8,858 17s. 7d., and which the Directors propose to deal with as follows:—

	£	s.	d.
To provide for dividend on 4½ preference shares apportioned to December 31st, 1896 (less tax) ...	797	9	9
To pay a dividend (less tax) at the rate of £7 per cent. for the half-year ended December 31st, 1896, on the ordinary shares, making with the interim dividend paid in August, 1896, £6 per cent. per annum for the whole year	5,075	0	0
And to carry forward	2,986	7	10
	£8,858	17	7

Mr. I. P. Mendoza and Mr. J. M. Gatti are the directors who retire by rotation, and, being eligible, offer themselves for re-election. The auditors, Messrs. O. R. Johnson and Son, also retire and offer themselves for re-election.

Newcastle-upon-Tyne Electric Supply Company, Limited.

The ninth general meeting of the shareholders of the above company was held Thursday, last week, at the Station Hotel, Newcastle. The chairman (Ald. Gibson), in moving the adoption of the directors' report and statement of accounts, said that the demand for electrical energy had again been very satisfactory, the units sold being nearly 90,000 in excess of last year. It had been necessary during the year to put down another complete set of generating plant, capable of supplying 5,000 16 candle-power lamps simultaneously. The company had also extended their mains to the Heaton and Byker district, the return from which had been quite up to expectations. The total length of main and branch cable laid was now equal to 17 miles. The report and accounts having been unanimously adopted, a dividend at the rate of 5 per cent. per annum for the half-year ending December 31st, 1896, was declared, which, together with the interim dividend paid in July at the same rate, made 5 per cent. for the year. A special resolution was passed increasing the capital of the company from £50,000 to £100,000. The retiring directors (Alderman Gibson and Mr. J. H. Armstrong) and the auditor (Mr. Thomas Harrison) were re-elected, and the meeting terminated with the usual votes of thanks.

The Kensington and Knightsbridge Electric Lighting Company, Limited.

The directors submit to the shareholders a statement of the accounts of the company, together with a report of the position of the undertaking at the end of the year 1896. The latter states that the mains, which extended to a length of 20 miles on December 31st, 1895, have been increased during the year 1896 to 21¼ miles. During the year the number of houses and shops connected with the system has increased from 1,109 on December 31st, 1895, to 1,325 on December 31st, 1896; while the number of lamps calculated on the usual basis of 8 candle-power has increased from 94,780 to 119,955. The balance of the £15,755 4 per cent. debenture stock issued at £105 per cent. in December, 1895, amounting to £3,974 5s., was paid in January. Additional capital required by the company during the year has been raised by the issue of £1,000 4 per cent. debenture stock at £107 per cent., and 1,000 second preference shares, offered to the shareholders at a minimum price of £6 per £5 share, were subscribed for, producing £6,059 5s. The directors have thought it advisable to appropriate the premiums thus obtained to the reduction of the cost of conversion of debenture bonds. The directors have written £2,000 off the capital expenditure in addition to replacement of plant, and strengthened the renewal account by transferring to it £2,345 19s. 6d., making the total amount placed to that account £12,336 13s. 2d. After providing for the above amounts, and paying the dividends on the 6 per cent. first preference shares to June 30th, 1896, on the 5 per cent. second preference shares to September 30th, 1896, and an interim dividend at the rate of 6 per cent. per annum on the ordinary shares for the first half of the

year, the balance standing to the credit of the net revenue account for the year 1896 is £6,425 3s. 9d. Of the above sum £1,450 has been appropriated to the payment of the first preference dividend to the end of the year, and £200 has to be set aside to meet the portion of the dividend on the second preference shares accrued to the same date, leaving £4,775 3s. 9d., out of which it is proposed to pay a further dividend on the ordinary shares, at the rate of 8 per cent. per annum for the past half-year, making, with the interim dividend paid to June 30th, 7 per cent. for the year. This will leave a balance of £1,875 3s. 9d. No provision has been made in the accounts for directors' remuneration; the directors propose, in accordance with a wish which was expressed by shareholders at the last meeting, to submit a resolution to the meeting, fixing the directors' fees for the year 1896, and subsequent years, at £1,000. In accordance with the articles of association, Sir Frederick J. Bramwell, Bart., F.R.S., and Mr. R. W. Wallace, Q.C., retire from the directorship, and being eligible, offer themselves for re-election. The auditors, Messrs. Lovelock, H W. S. Whiffin & Dickinson offer themselves for re-election.

The City of London Electric Lighting Company, Limited.

The directors submit the following report to their shareholders, and also a statement of accounts for the year ended December 31st, 1896, as certified by the auditors. The report says: The expenditure on capital account during the year ended December 31st, 1896, amounted to £73,724 17s. 1d. In view of the rapid extension of the company's business, the directors recommend that the company's capital should be increased, and the following resolution will be submitted at the forthcoming meeting:—Resolved: "That the capital of the company be increased to £1,200,000, by the creation of 40,000 new ordinary shares of £10 each." The directors propose, should the resolution be passed, to issue only 10,000 of the new shares at present, and the remainder as the business of the company may require. They propose to allot, as nearly as may be, the first 10,000 shares at par to the present ordinary shareholders, in the proportion of one new share to four old shares. The total revenue for the year was £156,021 19s. 11d., from which must be deducted the following items:—Expenses of generation and distribution, £38,162 2s. 6d.; rents, rates, taxes, general charges, and allowances to consumers, £30,820 8s. 6d.; transfer to depreciation fund, £14,950; transfer to reserve fund, £2,612 11s. 8d.; amount written off suspense account, £1,338 0s. 8d.; total, £87,893 3s. 4d.; leaving a net revenue of £68,128 16s. 7d., to which must be added the balance brought forward from 1895, £3,776 3s. 10d.; making a total available revenue of £71,905 0s. 5d. Of this sum the following amounts have been distributed:—Interest on debenture stock for year ended December 31st, 1896, £18,489 17s. 4d.; interim dividend on £400,000 6 per cent. preference shares, half-year to June 30th last, £12,000; together, £30,489 17s. 4d.; leaving for further distribution, £41,415 3s. 1d. The directors now recommend the following dividends, viz., 6s. per share on the preference shares for the second half-year, making, with the interim dividend already paid, a total distribution of 12s. per share, or 6 per cent. for the year, and 14s. per share on the ordinary shares for the year, being at the rate of 7 per cent. per annum. This will absorb £40,000, leaving a balance of £1,415 3s. 1d., which the directors propose to carry forward. They propose that the respective dividends shall be paid on February 25th, 1897. The necessary provision for depreciation and reserve fund in accordance with the City of London Electric Lighting Act, 1893, has been made, of which £17,572 11s. 8d. has been set aside out of revenue. The generation and distribution expenses for the year, including repairs and renewals, were 34 per cent. of the earnings, as compared with 36·87 for 1895, 46 for 1894, 54·2 for 1893. The company continues to make satisfactory progress, as will be seen by the following comparative statements, showing the position of the company with regard to its earning powers.

	Dec. 31st, 1895.	Dec. 31st, 1896.
Number of customers being supplied ...	4,230	5,303
Number (equivalent) of 8 C.P. lamps connected	195,317	247,785

On February 10th, 1897, there were 267,502 8 C.P. lamps (equivalent) applied for, out of which 254,610 were connected.

Statement of Income.

	For the year ended Dec. 31st, 1895.	For the year ended Dec. 31st, 1896.
Gross revenue	£106,999 17 2	£146,946 14 7
Net revenue available for depreciation, reserve fund, interest on debenture stock and dividends	£59,100 5 11	£85,701 8 3

In accordance with the articles of association, two of the directors, Sir David L. Salomons, Bart., and Colonel B. H. Martindale, C.B., now retire, and, being eligible, offer themselves for re-election. Messrs. W. H. Pannell & Co. retire, and, being eligible, offer themselves for re-election.

Western and Brazilian Telegraph Company, Limited.

An extraordinary general meeting was held on Monday, at Winchester House, to consider resolutions sanctioning the conversion of the debenture debt. Lord Richard H. Browne presided. After expressing regret at the absence of Mr. Andrews, and a hope that their colleague might speedily be restored to health, the chairman proposed the resolutions. The directors, he said, had had to offer the debenture holders such terms as would induce them to accept the conversion, and at the same time to take care that the shareholders' interests were in every way protected. They had received assents from the debenture holders to the amount of £282,600 out of a total of £338,800. The amount of the old debentures originally was £450,000, of which £200,000 were "A's," the balance being "B's." Both classes bore 6 per cent. interest. Up to the present £111,200 had been drawn and cancelled. If they continued as at present, the existing charge of £38,200 per annum for interest and sinking fund would continue until 1910. This was a heavy charge on their profits, and it had to be paid before a penny could be divided among the shareholders. Under the new scheme, however, the annual charge for interest would be £16,000 a year, being 4 per cent. upon £400,000; and the amount necessary for redeeming the debenture stock, which was to run for 70 years, would be £2,159 per annum. By this proposal, therefore, about £20,000 per annum would be set free for the benefit of the shareholders. The scheme proposed to create £500,000 of debenture stock, but the balance of the stock which was not required for effecting the exchange would only be issued by resolution of a general meeting. Any debenture-holders who, being executors or trustees, thought that they could not convert, would remain simply in their present position, and their bonds would be drawn annually until they were all extinguished. The interests of the holders of the debenture stock would be protected exactly as at present, the security being just the same, but their position would be materially improved by the fact that they would possess a permanent security, not liable to be drawn off at par. He believed that this would materially increase the market value of the stock. They had received from shareholders 704 proxies, representing 38,449 votes, equal to nearly £500,000, in favour of the scheme, and they had not had a single dissentient vote.

Mr. J. Coppen seconded the motion, which was carried unanimously.

W. T. Henley's Telegraph Works Company, Limited.

The directors' annual report for 1896 is as follows:—The accounts show that a net profit has been made of £26,077 8s. 7d. After payment of debenture interest and income tax, and making ample allowance for depreciation of plant, machinery, &c., there remains £20,527 0s. 5d., to which must be added £13,367 6s. 2d. brought forward from last year, making a total of £33,894 6s. 7d. From this must be deducted £1,050, the interim dividend on the preference shares, and £3,000, the interim dividend of 3 per cent. on the ordinary shares, both paid on September 1st last, and there remains a balance of £29,844 6s. 7d. Of this sum the directors have transferred £7,500 to reserve fund, and they propose the payment of a further dividend on the preference shares of 3½ per cent., making 7 per cent. for the year, and recommend the declaration of a further dividend of 7 per cent., free of income tax, on the ordinary shares, making a total distribution of 10 per cent. for the year, free of income tax. These payments together absorb £15,550, leaving £14,294 6s. 7d. to be carried forward. Mr. R. J. Jenkins, C.E., has recently resigned his seat on the board. Major-General George Hutchinson, C.B., C.S.I., and the Hon. Randolph Stewart retire by rotation in accordance with the provisions of the articles of association, and, being eligible, offer themselves for re-election. The auditors, Messrs. Ball, Baker, Deed, Cornish & Co., retire, and, being eligible, offer themselves for re-election.

An American Prospectus.—There have been offered for subscription in London this week, $350,000 first mortgage 5 per cent. gold debentures in the London Street Railway Company, which has the only street railway system in the City of London, Ontario, Canada, the lines being operated by electric power. The company's system was extended and converted from horse power to the present system; the total length of the lines is 21 miles. The list of applications was to close yesterday.

County of London and Brush Provincial Electric Lighting Company, Limited.—The directors have decided to recommend payment of a dividend on the preference shares for the six months ended December 31st, at a rate of 6 per cent. per annum on the amounts paid up thereon, less income tax, subject to confirmation at the general meeting to be held on March 8th.

Electric Construction Company, Limited. — The transfer books for the ordinary shares will be closed from 15th inst. to March 1st, inclusive, for the payment of the second half of the dividend of 5 per cent. declared on August 27th, 1896.

Stock Exchange Notices.—Application has been made to the Committee to appoint a special settling day in London Electric Omnibus Company, Limited, 50,007 shares, Nos. 80,001 to 130,007.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending February 14th, 1897, were £1,062; week ending February 16th, 1896, £949; increase, £113; total receipts for half-year, 1897, £7,674; corresponding period, 1896, £6,947; increase, £727.

The Liverpool Overhead Railway Company. The receipts for the week ending February 14th, 1897, amounted to £1,219; corresponding week last year, £1,134; increase, £85.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending February 12th, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,250.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Feb. 10th.	Closing Quotation, Feb. 17th.	Business done during week ended Feb. 17th, 1897. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	8½— 9½	8½— 9½	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 2s.	£2 9s.	£2 13s.	53 — 56	52 — 55 xd	53½	...
2,993,560£	Do. do. 6 % Pref.	Stock	£4 4s.	£4 18s.	£5 6s.	97 — 98	95½ — 96½xd	97⅜	95⅝
2,993,560£	Do. do. Defd.	Stock	...	...	...	8¾ — 9¼	8¾ — 9	8⅞	...
139,660	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	...	15½— 15⅝	15½— 15⅝	15⅝	15½
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	113 —117	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	...	3½— 3⅝	3½— 3⅝	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	...	170 —175	170 —175	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	...	3/16— 5/16	3/16— 5/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	...	12 — 13	12 — 13	12⅞	12½
5,000	Do. 10 % Pref.	10	10 %	10 %	...	19½— 20½	19½ — 20½ ‖	19 15/16	19½
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	...	3¾— 4½	3¾— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	4½%	4½%	...	105 —108 %	105 —108%	...	...
60,710	Direct United States Cable, Ltd.	20	2 %	2¼%	...	9 — 9½	9 — 9½	9½	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6¼%	6¼%	...	17 — 17½	17 — 17½	17 7/16	17
70,000	Do. 6 % Cum. Pref.	10	6 %	6	...	18 — 19	18 — 19	18⅛	18½
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	103 —105	103 —105 xd	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	130 —135	130 —133	132	130½
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	...	17½ — 18	17½ — 18	17 7/16	17 5/16
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	...	100 —104	100 —104	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	...	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	129 —132	130 —133	...	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	100 —104	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	107 —110	107 —110	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	...	109 —112 %	110 —113 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅛%	4⅛%	...	11 — 11½	11 — 11½	11⅛	11½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	17½ — 17¾	17½ — 17¾	17⅞	17¾
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	10 %	...	24½ — 25½	24½ — 25½	25½	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	...	53 — 56	53 — 56	...	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5½%	5½%	7⅝ — 7⅞	7½ — 7¾	7⅞	7½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	17 1/16	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6⅝— 6⅞	6⅜ — 6⅝	...	...
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	105 —108	104 —107	107½	105
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	4⅛%	5 %	...	1 1/16— 1 1/8	1 1/16— 1 1/8	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	...	106 —109	106 —109	...	...
11,839	Reuter's Ltd.	8	nil	5 %	...	7 — 8	7 — 8	7 1/16	7½
3,381	Submarine Cables Trust	Cert.	...	...	...	138 —143	138 —143	140½	...
58,800	United River Plate Teleph., Ltd.	5	3 %	4 %	...	3½— 3⅝	3½— 3⅝	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	100 —105	100 —105	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	nil	4 %	...	5 — 6	5 — 6	...	...
238,380£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	103 —106	103 —106	...	...
30,000	West Coast of America Teleg., Ltd.	10	nil	nil	...	⅜ — 1½	⅜ — 1½	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	98 —104	98 —104	99	...
64,248	Western and Brazilian Teleg., Ltd.	15	3 %	3 %	...	8¾— 9¼	8¾— 9¼	9	8⅞
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	...	6⅝— 7¼	6⅝— 7¼	...	...
33,129	Do. do. do. Def. Ord	7½	1 %	1 %	...	2⅝— 3¼	2½— 3	2 15/16	2½
165,200£	Do. do. do. 5 % Debs. "A," 1880 Red.	100	6 %	6 %	...	110 —114	110 —114	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	...	109 —113	109 —113	109	...
88,321	West India and Panama Teleg., Ltd.	10	⅞%	⅞%	...	1⅛— 1⅜	1⅛— 1⅜	1⅜	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	11½ — 12	11½ — 12	11⅜	11½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	9½— 10½	9½— 10½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	...	107 —110	107 —110	107½	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	...	107 —112	107 —112	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electy. Supply	5	4½%	5 %	6 %	10 — 10½	9½— 10	10	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	...	8½— 9	8½— 9	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	4½%	...	112 —115	112 —115	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	5 %	5 %	7 %	15½— 16½	17 — 18	16⅝	16½
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½ — 17½	16½ — 17½	17½	16⅝
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	129 —133	129 —133	131	...
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	nil	nil	9½ — 10	9⅝— 10½	...	...
20,000	Do. do. do. 6% Pref., 40,001—50,000 ...	10	...	6 %	6 %	14 — 14½	14 — 14½	14⅝	...
10,000	Do. do. do. iss. at 2 pm., all paid	10	...	...	...	10½ -- 10⅝	10½— 10⅝	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	3 %	4 %	...	13½ — 14½	13½ — 14½	14⅝	14
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem., £1 paid	10	...	...	...	7 — 7½	7 — 7½	7⅝	...
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	119 —122	119 —122	...	...
5,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	...	11 — 12	11 — 12	...	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	6½%	7½%	10½%	13 — 14	12½— 13½xd	13½	13¼
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9½— 10½	9½— 10½xd	...	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	5 %	7 %	9 %	11½ — 12½	11½ — 12½	12⅛	12⅛

* Subject to Founder's Shares.

† Quotations on Liverpool Stock Exchange.

‡ Unless therwise stated all shares are fully paid.

‖ Dividends paid in deferred share warrants, profits being used as capital.

§ Dividends marked § are for year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Feb. 10th.	Closing Quotation Feb. 17th.	Business done during week ended Feb. 17th, 1897. Highest.	Lowest
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	S	2½%	...	...	⅞ — 1⅛	⅞ — 1⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	1¼ — 1½	1¼ — 1½	1 7/16	...
125,000	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	...	...	109 —112	109 —112	...	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	94 — 98	94 — 98	...	...
9,104	Central London Railway, Ord. Shares	10	...	...	...	9½ — 10	9½ — 10	9¾	9⅞
207,649	Do. do. do. £6 paid	10	...	...	...	5½ — 6	5½ — 6	5⅞	...
630,000	City and South London Railway	Stock	1½%	1 5/16%	1 5/16%	59 — 61	59 — 61	60¾	60½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	1⅜ — 2¼	1⅜ — 2¼	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	5 %	5 %	...	1⅜ — 2¼	1⅜ — 2¼xd	1⅜	...
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	...	3 — 4	3 — 4 xd	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	4½%	4½%	...	105 —110	105 —110	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	...	1½ — 1⅝	1½ — 1⅝	1 11/16	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2½ — 3	2½ — 3	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	....	...	⅜ — 1⅛	⅞ — 1⅛	1	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	...	...	⅜ — ⅝	⅜ — ⅝	...	...
9,600	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	10½%	...	10½ — 11½	10½ — 11½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	10 %	19 — 20	19 — 20	19½	19 5/16
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	4½%	109 —114	109 —114	...	...
58,000	Indis-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅝	21½
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	106 —109	106 —109	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	2⅞%	2⅞%	13⅛ — 13⅜	13 — 13⅛xd	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	...	16½ — 17	16 — 16⅜xd	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	15 %	40 — 43	39 — 42	40⅜	40½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £8 paid ...	10	...	...	...	9⅜ — 10½	10 — 10½	10½	10½

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50 % for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1893—7½% 1896—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 9.
Electric Construction Corporation, 6 % Debentures, 101—104.
House-to-House Company (£5 paid), 4⅜—5¼.
Do. do. 7 % Preference, of £5, 8¾—9¼.
Do. do. 4½% Debentures of £100 107—109 xd.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 10½—10¾; 1st Preference Cumulative 6 %, £5 (fully paid), 8—8¼. Dividend, 1896, on Ordinary Shares 7 %.
London Electric Supply Corporation, £5 Ordinary, 1⅜—1⅝.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8½—9. Dividend for 1896—7 %.

* From Birmingham Share List.

Bank rate of discount, 3 per cent. (February 4th, 1897).

ELECTRICITY SUPPLY AT 230 VOLTS.*

By ALFRED H. GIBBINGS.

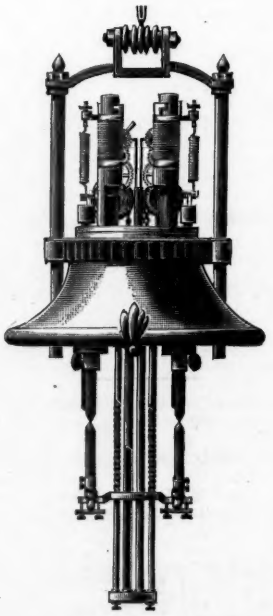
(*Concluded from page* 228.)

V.—Arc Lamps.

Referring for a moment to the earlier portion of the paper, it will be seen that the number of arc lamps in Bradford, both public and private, is 433. Of these there are eight public lamps, leaving 425 private arc lamps, of which about 400 were coupled, two in series on 115 volts, 12 months ago. These 400 arc lamps must be further divided into two classes, viz.:—

1. Consumers using more than two arc lamps, 40 = 365 arcs.
2. Consumers using two arc lamps only, 30 = 60 arcs.

It will now be seen that, in order to change over these arc lamps, it was necessary in regard to the first-class just mentioned to get as many lamps as possible re-connected, four in series instead of two in series. This has been the only serious and important task in connection with the entire change, as it primarily interfered very greatly with the convenience of the consumer, which was the chief thing we endeavoured to avoid. However, this did not prove to be entirely an evil or even an annoyance. As in the case of wiring, so with the arc lamps, we found that the more modern lamps were readily re-adjusted, and as each lamp was individually dealt with for its proper ampereage and voltage, and the correct resistance left in circuit, some improvements in the way of effective working were consequently obtained. These little details of careful adjustment had obviously been neglected altogether when the installation had been first carried out. Most lamps were exceedingly dirty, the working parts not having been cleaned for years. Other little difficulties occurred as we passed from consumer to consumer. One individual has six arcs, and we had to promise two special lamps for him; another had four arcs, but two were inside the shop, and two were outside, and it was obvious that we could not ask him to be burning all at the same time. All difficulties have, however, been surmounted, and I may add, to the mutual satisfaction of the consumers and ourselves. As a matter of fact, the consumers have had their lamps cleaned and put in good condition. The lamps of one consumer in particular we found taking 17½ amperes. He, of course, was in entire ignorance, but he wisely replaced them, and at once got a better light, and reduced his account 50 per cent. Several similar interesting facts could be given, illustrative of how much good has resulted from a little evil. I will, however, only mention further that our experiences suggested the idea of hiring out arc lamps, which has been so satisfactory and so well appreciated, that 20 were left on hire during December last, and inquiries continue to be made.



It would be invidious for me to make any comment here as to the facilities of adjustment in the various makes of arc lamps; but I may at least say this, that for accuracy of adjustment, for feeding at a definite potential across the arc, and for perfect steadiness, I am strongly in favour of the simple shunt type, especially where there is any pretension to keep an unvarying voltage on the mains.

* Paper read before the Northern Society of Electrical Engineers, February 8th, 1897.

The second class of consumer with whom we had to deal was he with only two arc lamps. At the discussion on high voltage supply at the meeting of the Municipal Electrical Association last year, I remember that the question of two arc lamp customers was considered even a greater obstacle in the way of supply at 230 volts than that of four or more arc lamp customers. Our experience has been exactly the reverse of this; we have had no difficulty whatever, and the change was made as simply as with incandescent lighting only. The accompanying illustration shows a form of 5-ampere double carbon arc lamp, which has been designed by myself to take the place of the ordinary 10-ampere single carbon lamp, and I have brought one here for inspection.

In addition to these double carbon arc lamps, there has also been used those of the enclosed type with an inner globe. Both types have given great satisfaction.

VI.—Incandescent Lamps.

At this stage of the paper there should be little necessity for me to support the statement that the high voltage incandescent lamp, as it is now designed and made, is equal in durability, efficiency, and excellence of construction to the best types of those of the lower pressures. I make the comparison with the best types of lower voltage lamps advisedly, because there are many forms of indifferent, and, therefore, worthless lamps of both high and low voltages, and also because in lamps of either pressure we can sacrifice length of life for diminished watts per candle, and *vice versâ*. The watts per candle for which we stipulate in all consignments of high voltage lamps are 3·6, and after many hundreds of tests of promiscuous lamps, the average is as near that figure as possible. With regard to so-called high efficiency lamps, cheap 115-volt lamps, and others which have been correctly designated "worthless," I was glad to see some time ago an excellent article in the London *Daily Telegraph* on the subject, in which the general public, users of the electric light, were very properly warned against purchasing these inferior makes. This article has been reproduced by the Edison & Swan United Electric Light Company, and issued in the form of a pamphlet. But the public, unfortunately, will still buy cheap lamps, whatever the supply pressure may be—ignorant, we will assume, that it means a rapidly decreasing light, expensive renewals, and a heavy electricity bill. It will be giving away no secret, nor will it be anything to the detriment of 230-volt lamps, when I say that it was an unexpected repetition of experiences showing the worthlessness of cheap lamps which led to the strong recommendation I made last year to the Bradford Corporation, and which they unanimously adopted, to supply renewals of lamps free of charge. This decidedly new departure is in itself, of course, a welcome boon to the consumer, but it is to bring in its train a still more acceptable thing to at least 75 per cent. of our customers, viz., a reduced consumption of electricity. The innovation has justified itself in two ways. First, in the decrease in the accounts of our consumers during the last half-year, and, secondly, in the diminished load at the station compared with the estimated load through the ordinary increase in new consumers. The experiences to which I have referred, and the results of which I have just mentioned, are yet other instances of the outcome of taking careful tests of every consumer's installation. I consider that it very largely supersedes the hitherto theoretical argument used by some engineers as to the comparative efficiency of low over high voltage lamps. These experiences, or rather observations, of which we were not directly in search, came about as follows: Upon entering on the practical business of changing the pressure and consequently the lamps of each consumer, we invariably used the opportunity to take the maximum current demanded first with all the old lamps on, and again with all the new lamps on. Of course, some difference in consumption was naturally to be expected between old and new lamps, but the very wide differences we discovered entirely in favour of the high voltage lamps could only be explained by great inefficiency in the 115-volt lamps. I have thought that after the statements just made it would be interesting to place before you some of the photometric and efficiency tests to which I submitted some of these cheap lamps taken from consumers' installations. The lamps tested were new lamps taken from the consumer's spare stock.

Test of various Types and Makes of 115-volt Incandescent Lamps.

Type No.	Voltage.	Nominal candle-power.	Mean volts when testing.	Actual candle-power.	Amperes.	Watts per nominal candle-power.	Watts per actual candle-power.
1	115	16	114·99	12·94	·465	3·34	4·13
2	115	16	115·85	11·99	·450	3·23	4·42
3	115	16	115·76	12·38	·570	4·10	5·30
4	115	16	115·80	12·10	·550	3·94	5·22
5	115	8	115·87	9·6	·364	5·23	4·46
6	115	8	115·93	7·24	·374	5·38	5·94

The only further remark I have to make in connection with the foregoing test is that if we in Bradford have found such evidences of the extensive purchase of inferior lamps, then in all probability other towns are suffering from similar drawbacks, and my advice is to get rid of them in the only effective and satisfactory manner, viz., by supplying from headquarters the best lamps that can be obtained, on a basis likely to attract the user of the current.

With reference to our tests of high voltage lamps, it is only fair to say that I have met with specimens equally disreputable. For instance, two nominal 16 candle-power lamps were submitted to me in October last as samples, for which orders were asked, and although sample lamps at least, one would think, would be carefully tested, the results certainly seem to point to the contrary in this instance. The actual candle-power of each lamp was 17·6 and 22·3 respectively, and the watts per actual candle-power 6·15 and 6·02. Of course, no orders were given, and with our free supply of renewal lamps, I do not think our consumers in Bradford are likely to get them.

Before leaving the subject of high voltage incandescent lamps, I wish to say a word particularly with reference to those of 8 candle-power. The 8 candle-power 230 volt lamps have proved satisfactory beyond our expectation, and if reference is made to the list of lamps in the first part of the paper, it will be seen that we have now no fewer than 2,492. A considerable number of these (about 525) have been in continual use in the Great Northern Hotel, Bradford, since May 3rd, 1896, when the lamps were changed, and the manager, Joseph Weber, Esq., has written us the following reference as to his experiences of them, viz.:—

"I have found the 8 candle-power lamps perfectly satisfactory, and we have a better light than with the previous lamps. The account has also been reduced by about £50, owing to the substitution of some 8 candle-power lamps for 16 candle-power."

The better light mentioned by Mr. Weber is undoubtedly due to the lessened fall of potential within the building.

The 8 candle-power lamps in use in this hotel were made by the Zurich Incandescence Lamp Company, and out of the general consignment supplied to me, I took six for the purpose of testing their candle-power, efficiency, and life, and these six lamps I have here on the table before you. They were put in circuit on April 21st, 1896, and were taken out on December 30th, 1896, having been continuously on circuit for 6,072 hours. As they are still each intact, it is impossible to say what their life may be. The following tests were made of two of the lamps at different periods:—

Test of Two "Stearn" 8-candle-power 230-volt Incandescent Lamps.

Hours in circuit.	No.	Mean volts at test.	Actual candle-power.	Amperes.	Watts per nominal candle-power.	Watts per actual candle-power.
New	1	230	9·1	·141	4·05	3·56
	2	230	9·3	·137	4·05	3·50
1,000	1	230	7·6	·141	4·05	4·26
	2	230	7·5	·141	4·05	4·32
3,844	3	230	4·26	·150	4·31	8·00
	4	230	6·24	·150	4·31	5·54
6,072	1	230	3·8	·141	4·05	8·76
	2	230	3·7	·141	4·05	8·53

If we take the average life of a lamp at 1,000 hours, which is the basis upon which the free lamps are distributed in Bradford, it will be seen that the efficiency at that life in the preceding test is very good. There are now many manufacturers of high voltage lamps, and the difficulty which was once experienced in obtaining them no longer exists. A healthful competition has now set in, and if a fair and reasonable price is paid and the lamps are each marked with the candle-power, voltage, and the maker's name, these guarantees ought to be amply sufficient, and after all it will be merely taking the same precautions as are equally necessary when purchasing 115-volt lamps.

VII.—Changing Over.

In bringing my paper to a conclusion, it may be of interest to give a short description of the methods adopted for changing over from the lower pressure to the higher. During the latter end of 1895, and the first half of 1896, many alterations in the system of supply were completed which were commenced prior to my advent. They included (1) the laying the third main in about half of the town, which had not up to that time been supplied on the three-wire system; (2) laying an additional service cable in each consumer's premises, thus enabling the supply to be given either from the outers or the middle and outer mains; (3) altering the winding on some of the dynamos at the station and re-calibrating instruments for 250 volts.

The additional wire for each consumer was therefore put in under peculiarly favourable conditions, enabling us also to accomplish the actual change in each case with a minimum of time and trouble. At the present moment we are working on a simple two-wire system at 230 volts, the middle wire lying useless, until the time of light load in the summer, when we shall proceed as follows: The middle wire at the station and at the feeder ends will be connected together, and all consumers will be transferred from the coupled outer to the middle wire. This appears a large undertaking, but it will be seen that as we have the three cables in each premises, and a single-pole fuse box on each cable, the operation entails transferring only the installation wires from one box to another, an act of a few minutes duration. All our consumers having then been transferred to the middle wire, the coupled outer main will be freed from its connection with the middle both at the feeder ends and at the station, and the three-wire system at 460 volts and 230 volts will thus be established. It will only then remain to re-transfer a portion of the consumers and equally distribute the machines at the station to obtain a properly balanced three-wire system. The additional and third service cable, which it has been necessary to provide for this purpose, will not entirely end its functional usefulness at that time. It will no doubt in many instances in the future give great facilities for nicely regulating the balancing of the maximum demand as the supply increases and new consumers are added, as it will always be an easy matter to take any section of the mains and distribute the load upon it in equal proportion on either side of the system.

Finally, I wish to say that, in dealing with the subject of my paper, I have endeavoured to place before you the facts and experiences in detail just as we have found them. Experience has been wanting, I believe, with regard to details; the broad and general principles and the advantages of such a change are better known.

I have endeavoured to show, first, the practicability of supply at 230 volts; and, secondly, the obstacles and alterations which will have to be taken into consideration and encountered when changing any existing low tension three-wire continuous current systems to the higher voltage. Where a borough or district has any pretension to size, and is at present supplied on the lower pressure system, I believe that the trouble entailed in the change over is not to be considered side by side with the resultant advantages. As regards the battle of the systems, however, I am not taking up the argument here, nor do I espouse the entirely one-sided view professed by some engineers. I think the 230-volt lamp has a future of its own, both in alternating and continuous current systems of supply, and as such, its wider adoption and use is merely a matter of time and confidence.

GASEOUS FUEL AS A MEANS OF CHEAPENING ELECTRICITY.*

By NELSON W. PERRY, E.M.

(*Concluded from page* 203.)

Unquestionably, the gas engineer has the advantage of the electrical engineer in his method of distribution, but he has this advantage solely through the apathy of the electrical engineer, and not through any inherent right. The facts are, indeed, the other way, for the pressure at which the gas engineer may distribute his gas is limited to that at which gas can be burned at its most efficient rate. No such limitation is placed upon the engineer who distributes gas for fuel purposes. Compressed air is being daily delivered through 20 miles of pipes with a pressure at the point of delivery of approximately 100 lbs. to the square inch and a leakage loss not to exceed 10 per cent., and gas for fuel purposes can be delivered through the same pipes at the same pressure and leakage, whereas for illuminating purposes the final pressure is limited to a fraction of a lb. in pressure to the square inch, but even under these conditions the Consolidated Gas Light Company, of New York, is distributing gas from the Harlem river clear down to the battery—a distance of 13 miles,

Total initial pressure in inches required to deliver gas.	H.P. delivered 25 cu. ft. 1 H.P.H.	Ft. lbs. per second consumed in transmission.	Velocity of flow in feet per second.	Per cent of power transmitted con-transmission.
1·04 in.	500	17·3	4 ft.	0·007
2·085 „	720	51·5	6 „	0·013
3·15 „	920	105·12	8 „	0 0208
4·189 „	1,020	151·5	8·8 „	0·027
5·215 „	1,120	204·7	9·6 „	0·033
6·28 „	1,280	284·	11· „	0·04
7·34 „	1,360	358·	12· „	0·048
8·39 „	1,440	430·	12 5 „	0·054
9·4 „	1,540	501·	13· „	0·06
10·46 „	1,600	602·	14· „	0·07

and the Gas Light and Coke Company of London is delivering gas over 70 miles of territory through 2,000 miles of mains to a distance of 17 miles from its station. On the same investment in pipes, therefore, a far greater gas delivery can be made for power purposes than can be made for lighting purposes, and the electrical engineer who will deliver his energy to his centres of distribution in the gaseous form will have an enormous advantage over the gas company by reason of his ability to distribute his gas at greater pressure.

But he must be careful not to throw away the advantage thus gained by distributing his electrical energy over too extended areas. It is my conviction that the tendency to increase the radius of distribution is in the wrong direction, and that our solution is in the contrary direction, viz., in increasing the number of our centres and decreasing the radii.

As regards the economy of distribution of energy in the gaseous form, I gave some figures in another place† which I ask permission to quote here.

I assumed that we wished to transmit our gas to a distance of 5,000 yards, or nearly three miles, through a 12-inch pipe; that this gas has a specific gravity of 0 55 as compared with air and that its calorific power was such that when burned in a gas engine under fair conditions it would require 25 cubic feet to produce one brake H.P. hour. In order to allow for bends, I assumed that there were twenty-five 90° bends, an average of one every 200 yards. The results obtained under varying initial pressures were as in the following table.

This shows that by this means 1,600 H.P. can be delivered under 10 inches of water pressure through a 12-inch pipe with twenty-five 90° bends at a distance of 5,000 yards with an expenditure of but 1·12 H.P. or $\frac{1}{100}$th of one per cent. of the power delivered.

The Gas Light and Coke Company of London, in its straight-away transmission of 17 miles, which is comparable with some of our longest electrical transmissions, uses 30 inches initial pressure. With this pressure we could deliver through the 5,000 yards of 12-inch pipe approximately 2,700 H.P., with an expenditure of about $\frac{17}{100}$th of one per cent. of the power delivered.

Inches water pressure.	Cubic feet delivered.	Increase of pressure required for each 90 bend.	Total increase of pressure for 25 90 bends.
1 inch	12,500	·0016 inch	·04 inch
2 inches	18,500	·0034 „	·085 „
3 „	23,000	·006 „	·1495 „
4 „	25,500	·0076 „	·189 „
5 „	28,000	·0086 „	·215 „
6 „	32,000	·0113 „	·28 „
7 „	34,000	·0135 „	·34 „
8 „	36,000	·0147 „	·39 „
9 „	38,500	·0158 „	·4 „
10 „	40,000	0183 „	·46 „

The cost of this pipe, which would weigh 800 tons, would be at present prices $16,000. If we should endeavour to deliver 2,700 H.P. electrically to the same distance with the same efficiency of transmission at 10,000 volts, it would require copper equivalent to forty-seven 0000 B. & S. wires, which would weigh 900,000 lbs., and cost, at 12 cents per lb., $108,000, or six and a half times as much as the gas mains, and require transforming down after it was delivered before it could be utilised.

The above estimates allow nothing for leakage, which in gas mains is sometimes, though not necessarily, very large. According to Mr. James McGilchrist the losses in leakage on the 2,000 miles of mains of the London Gas Light and Coke Company, through which a maximum of 128,000,000 cubic feet per day are delivered is only a fraction over 5 per cent.

The extreme cheapness of transmission of gas distribution enables the gas manufacturer to locate his generating plant where real estate, coal, and water, are cheap, and thus we find all of the gas plants in New York City located on the water front, whereas the principal electric light plants are placed on the most expensive land at such a distance from the water front that the hauling of coal and the disposal of the ashes costs one of the most favourably located of these plants 54 cents. per ton on an aggregate of some 50,000 tons of coal per annum. Water for condensing or other purposes costs the largest consumers in New York 10 cents. per 100 cubic feet, rendering it in most cases more economical to operate engines non-condensing than to run them condensing.

These facts and the further fact that the gas manufacturer utilises the majority of his generating plant continuously and at its maximum efficiency, explain why on an investment of less than one-third he can accomplish essentially the same results more cheaply than can the electrical engineer.

The gas engineer, by reason of the facility of storage of his product, has practically no standby losses and his total investment is constantly worked to nearly its maximum capacity. About the only part of the plant not so continuously employed in his distributing mains, for these are not employed to their fullest capacity except for an hour or two each day. He has avoided these inefficiencies over a portion of his system, however, by establishing distributing gas holders at convenient centres, so that the mains connecting these distributing tanks and the generating plant are continually employed, and only those radiating from these centres fall short of their full earning capacity.

The electrical engineer has appreciated the effect of the variable character of his load upon the earning capacity of his plant, and some of the most progressive engineers are convinced that it is economical to supplant the extra engines and dynamos necessary to take the peak of the load with storage batteries which cost as much as, if not more than, the apparatus displaced. But his transmission and distribution lines, which cost more than those of the gas plant, as we have seen, are still utilised to their full extent but a small portion of the time. To obviate this the booster system with outlying storage battery centres of distribution has been suggested and in some cases employed, and this, it seems to me, is a step in the right direction. But we must go further. We must first of all materially reduce our enormous fixed charges, and next we must find some means of reducing our operating expenses and accomplish both of these reforms without sacrifice of reliability of service.

Can we do better than to take a lesson from the gas engineer who has already solved in a measure these problems? I not only think we can profitably copy after him, but that we can possibly go him one better.

The first step would be to move our generating plants from the expensive sites now occupied and place them on cheaper land where water and fuel may be had most cheaply. If by this move we can save in our coal bill 50 cents on every ton of coal costing, say, $2.50, we have at once made a material gain in operating expenses as well. If by adopting gaseous transmission we can cover a vastly increased area at the same cost, we have made another gain, and if by converting our coal into gas we are enabled to utilise coal that costs $1.00 or $1.50 per ton, whereas before we were paying $2.50, another material gain has been accomplished.

If by reason of the exceedingly cheap method of gas storage, which when employed on a large scale, can be provided on an investment of

* Read before the North Western Electrical Association at Milwaukee, January 21st, 1897, and courteously sent to us as an advance proof by Mr. Perry.

† "Gas *v.* Electricity for Power Transmission." The *Engineering Magazine*, October and November, 1896.

but $1.50 per H.P. hour capacity,* we can employ the real estate occupied, the buildings, apparatus, labour and administrative force to their fullest capacity, we have again reduced very materially both our fixed charges and our operating expenses.

We have seen that one gas company in London is supplying 70 square miles of territory through 2,000 miles of pipes with a leakage loss of but a fraction over 5 per cent., and that it has a straight away transmission of 17 miles. The economical distribution of gas over areas much larger and to distances much greater than have ever been attempted electrically by the direct current is therefore no longer an experiment but an accomplished fact, and this fact becomes still more impressive when we realise that after paying all the expenses of such transmission and the gas company's profit, we can buy that gas and produce more light from it through the intermediary of the gas engine and dynamo at less expense than we can buy electric light or than we could get from the same amount of gas burned in the ordinary way.

If these be facts they are very impressive and should stimulate us to see how far we as purveyors of electric power and light can avail ourselves of them.

My own suggestion, expressed on several previous occasions, is this:

Locate a gas generating plant with regard to economy of land, fuel, &c., and instal at this point a large gasholder, so that every dollar of investment at that point would have a maximum earning capacity. Taking advantage of the greater economy of gas over electrical transmission, transmit this gas to local centres of distribution. At these points smaller gas holders should be erected, so as to enable the gas mains to be used to their maximum capacity. Gas engines would take the place of steam boilers and engines, less space would be required and standby losses entirely avoided. If our load line were such as to warrant the introduction of storage batteries, these would supplant the local gas storage, and the real estate at this point, and dynamos, engines, and labour would all be employed continuously to their best advantage. In fact, every dollar of investment from the gas generating plant to the electrical plant at the local distributing centre, including the gas mains, would be employed to its best advantage, leaving only the electrical distributing mains to be employed under a low load factor.

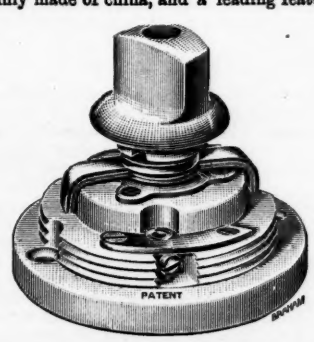
The economies in investment and in operating expenses thus accomplished would enable us to reduce the radii of distribution, and thus to give the same service with less investment of copper or better service with the same investment, and to reach unsupplied territory at a profit, not now accessible nor profitable by present methods.

I do not know just what proportion of the total cost of illuminating gas is due to the refinements of manufacture rendered necessary for the service it supplies, but it is undoubtedly large. Gas sufficiently clean for fuel purposes, without its high illuminating properties, but of nearly equal calorific power, could doubtless be manufactured for considerably less than it costs the illuminating gas companies. The fact, too, that it could be distributed at very much higher pressures would make still further for economy.

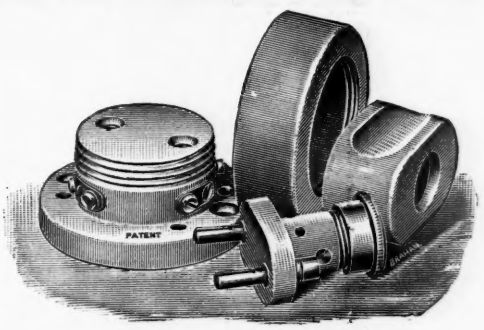
As to the quality of the gas, it will pay to generate such as has a high calorific power if it is to be transmitted far. If to be generated locally and used on the spot, a low grade, such as the Dowson gas, having a calorific power of about quarter that of ordinary 16 C.P. gas would undoubtedly be the most economical, but by reason of the greater volume required and of the greater frictional losses due to its greater specific gravity, such a gas would be less economical where long transmissions were involved than the richer and lighter gas produced at somewhat higher first cost.

HIGH VOLTAGE FITTINGS.

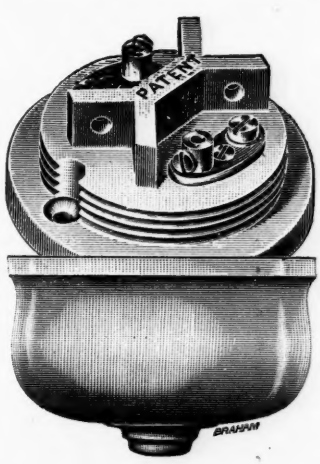
The General Electric Company have constructed and patented a system of switches, fuses, wall plugs, ceiling roses, &c., adapted for use on circuits of high voltage, *i.e.*, from 150 to 250 volts. These fittings are mainly made of china, and a leading feature is the introduction of china walls or partitions between the conducting parts of opposite polarity, and between points upon which the circuit is broken. This construction of such fittings does not materially increase their size, simplicity, or effective working, but it prevents the forming of destructive arcs. They are claimed to be thoroughly fire proof, have no surface leakage, and are especially designed to prevent short circuits or accidental shocks.

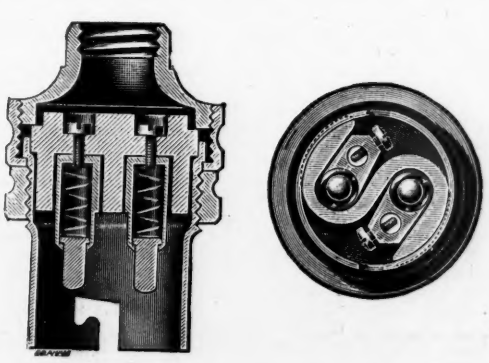


The High Voltage Switch is made with bridge contacts, and has double break action. The central brass plates, screw and spring action, are placed inside the china-protected recess. Their construction is said to ensure a quick and long break. The design of this switch is said to render it impossible for the arc to jump over or follow the contact when broken, this being one of the principal precautions required with such switches.



One of the weakest parts of a house installation is often at the wall plugs. These fittings contain both poles, and are frequently handled carelessly by the users, and are thus often the cause of short circuits, shocks, and breaking of fuses. The connecting tubes of the wall plug illustrated are embedded inside a circular piece of solid china. Their breaking points are about one inch apart. The terminals are connected on the outer circumference of the china block, and can be wired direct, with or without fuses. The removable plug is so constructed that it divides the two flexible cords carrying the opposite poles, and at the same time forms a safe and effective cord grip.

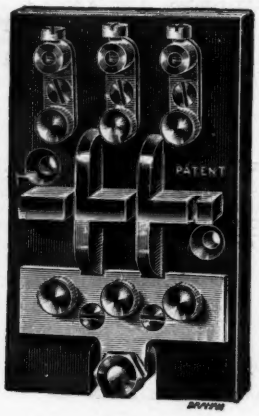




The ceiling rose is divided by a china wall, so as to separate the terminals. The flexible cord carrying the current is wired through two holes on the opposite side wings of the china wall, which thus act as cord grips. In the lampholders, which are of the bayonet

* A 500 foot holder would cost, erected in New York, about $700. A 1,000 foot holder, $900 to $1,000; a 150,000 foot holder, $15,000; and a 3,000,000 foot holder, $180,000. Assuming that a gas engine requires 25 cubic feet per H.P. hour, which is exceedingly liberal for the best types of modern gas engines using gas of the average quality of our ordinary illuminating gas, the investment per H.P. hour capacity for the largest sized tank named would be as given.

pattern, the spring terminals are fitted on china with walls in the form of the letter "S" protecting the conducting parts from possible short circuits, as shown in the illustration.



We give also an illustration of a cut-out board, which is called the patent R. T. cut-out. A china piece divides the terminals, and this piece, again, is provided with slots in which the fuses are placed. Its effect is to prevent destructive arcing, mostly set up under the sudden break of the fuses.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

ELECTRIC INTERLOCKING THE BLOCK AND MECHANICAL SIGNALS ON RAILWAYS. By F. T. HOLLINS, Member. Paper read January 28th, 1897.

(*Continued from page* 230.)

I may here explain that on the Great Eastern Railway we have so arranged this slot in the tappet that, although the lever cannot be put right back, so as to allow of another train being accepted, it can be put sufficiently back to throw the signal to danger in case of emergency.

On the train leaving "A," "Train entering section" is given on the bell to "B," and on its passing over the rail contact, 18, the circuit is closed and the back-lock is released, the signal put to danger and relocked, and the *line* wire again connected to the locking coils, 1, the rail contact circuit being left disconnected. In response to the "Train entering section" signal, "B," turns the switch hook, 15, which, breaking the line momentarily (by separating the two springs, 14 and 14*a*, and thus, coil, 17, releasing the armature and allowing disc, H, to fall in front of the "Train accepted" disc, 21), indicates to himself "Train on," and to "A" "Line blocked," by raising the small semaphore arm. Should, however, "A" have omitted to give "Train entering section" to "B," the act of putting his signal to danger behind the train at "A," gives "Train on" to "B," through the tripping piece, 24, on the switch rod, 20, pressing against the spring, 25, in passing it, and thus momentarily breaking the line circuit.

After the train has passed "B" and the signal has been put to danger, the switch hook, 15, is turned back off the plunger, 13, and the putting back of the signal lever, 12, again raises the rod, 27, carrying the "Train accepted" disc, 21 (see fig. 11), and the "Train on" disc, H, is also raised, by the little rod, 28, on the top of rod, 27 (fig. 9); the "Train on" disc is afterwards held up electro-magnetically by the coils, 17, and the small battery, 26.

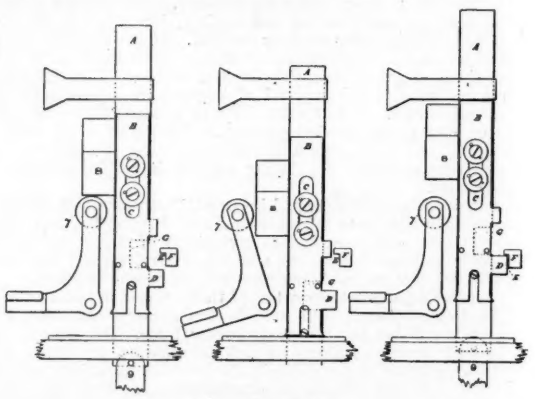
The Sykes apparatus was originally joined up to transmit a positive current to unlock the lever; but in view of *possible* lightning effects, I have recently had this reversed, so that a strong negative current unlocks the lever, and a constant positive current is required to indicate "Line clear." A constant negative current such as might be due to a contact if strong enough to unlock the instrument, would indicate "Line blocked." Lightning currents are, I think, generally positive currents, and, therefore, in the wrong direction for unlocking the instrument when thus joined up. If, however, a momentary current, such as might be due to contact, or possibly lightning, *should* unlock the instrument, it would only alter the *block* indication momentarily, and this would immediately resume its previous indication. A disconnection of the line, or the line to earth, would indicate "Line blocked," and of course leave the lock unaltered. If, whilst the line is indicating "Line clear," and after the lock has been released at the box in the rear, and the instrument in advance indicates "Train accepted," the line wire was disconnected or put to earth, it would alter the indication of the instrument to "Line blocked" at the rear box.

It will be seen that, although these are merely minor points, they are all in the direction of safety.

Now, it must be obvious that if, in putting the lever back in the frame, the armature is not lifted close up to the poles of the magnet (and the small wheel, 7, under the catchpiece, 8, of rod, 9), the rod will fall, and the lever be unlocked. This is a somewhat rare fault; but, in order to prevent it, the rod must be adjusted to give a certain overlift so that the wheel goes completely underneath the catch, 8, and the armature be held tightly up to the magnet by the lifting piece, 29, which is provided with a buffer spring to prevent any violent impact of the armature on the cores of the coils. If this overlift was *always* given such a fault would never occur.

But I was not satisfied with this, and I have had all the instruments fitted with a simple device on the locking rod, 9, *compelling* this overlift, by making it impossible to plunge to accept a train unless not only the signal is at danger, but locked in that position. If, therefore, it falls to "Free" when the lever is put back, the signalman is compelled to raise the rod with his hand and so lock it. It was pointed out that the signalman could then, if he chose, by pressing the plunger whilst in the act of raising the rod, plunge without being locked. I should hardly think he would try to do this; still, a small cavity was then cut in the plunging piece to so coincide with this safety device that this cannot now be done.

Fig. 12A shows diagrammatically how this is effected, and a specimen is on the table. A is the locking blade attached to rod, 9 (figs. 10 and 11), held up by the small wheel, 7, engaging under the catch-piece, 8, at the same time that the armature is held up by the permanent magnet. To the locking blade, A, is attached a metallic friction piece, B, binding against A, but free to move independently to the extent allowed by slot, C. The friction piece, B, has a projection, D, to engage in the cavity, E, of the angle piece, F, which is part of the plunger for transmitting the current to unlock the controlling signal at the box in the rear.



FIGS. 12A, 12B, 12C.

Now, as shown in fig. 12A, the instrument is in the locked position and the angle piece, F, coinciding with the cavity between D, and the upper portion of a slot, G, in the locking blade, A, is free to allow the plunger to be operated—that is, so far as the locking blade is concerned. If now the lock is discharged, the blade, A, and the friction piece, B, fall into the position shown in fig. 12B; when they are again raised to the locked position, the overlift is given as shown in fig. 12C, where D is shown engaged in cavity, E, of the angle piece, F, and the catch piece, 8, is raised a corresponding distance above the wheel (which is also the measure of the overlift), and is a little beyond the point where the armature "clicks" on the pole-piece of the magnet. Blade, A, is then allowed to fall so that catch-piece, 8, again rests upon the wheel and the projection, D, of the friction piece, B, is then clear of the plunger angle piece, F, as shown in fig. 12A. If the cavity, E, were not cut in angle piece, F, the upper portion of D, would engage with the bottom of the angle piece when the plunger was pressed in by the hand, and thus, by wriggling the plunger and the rod, plunging would be possible whilst the lever was still unlocked.

THE RAIL CONTACT.

In any complete system of electric interlocking there can be no doubt that the rail contact, or treadle, is the most important factor to be considered, because upon its reliability the safety of the system mainly depends. It is the means that shall indicate the presence of the train clear of the section to which it refers, and is really the positive permission to the signalman to admit a following train into the section. It is essential that a rail contact should only be actuated by the weight of an engine or carriage. It will not do to be merely actuated by the flange of a wheel. It must not be capable of being actuated by a trolley, or being walked over, or jumped on, or by a bar, or other reasonable weight, falling upon it. It must not be capable of being operated by hand, or other means but the deflection of the rail. The battery must be fixed near the contact, *and not at the signal box*, so that any failure of the circuit must be, as the Government inspector remarked at a certain inquiry, in the direction of safety.

Both Sykes's and Siemens's contacts are doubtless excellent examples, and both are carried on the rail itself.

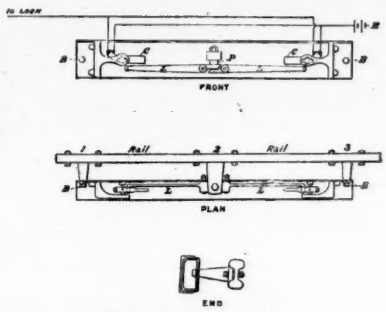
Sykes's contact is shown in figs. 13, 14, and 15, and a model is on the table.

Three cast-iron brackets, 1, 2, and 3, are secured to the rail, and the treadle bolted to 1 and 3 by bolts, B, B. The centre bracket has an adjustable pin, P, which passes through a slot, and rests on the tails of two levers, L, L, the extreme ends of which are under the mercury cups, C, C. The weight of an engine or coach over the spot, P, results in the tilting of the mercury cups, thus making or breaking contact, as the case may be.

Siemens's contact is shown in figs. 16 and 17.

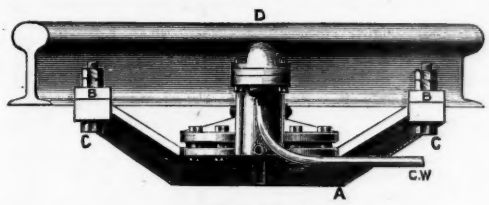
Fig. 16 shows a side view of the complete apparatus attached to a rail, and fig. 17 is a section, showing the working parts of the apparatus.

The contact maker is supported by a strong cast-iron beam or small girder, A, which, by means of claws, B, B1, and screws, C, C1, is firmly screwed to the bottom flange of the rail, D. In the centre of the beam is a broad shallow dish, the rim of which is covered by a thin steel plate, similar to the diaphragm or membrane of a telephone. On this iron diaphragm rests an iron disc, *c c* (fig. 17). which is held at the centre by the plunger, *d*. This plunger is so adjusted



Figs. 13, 14, and 15.

that it just touches the under surface of the rail when the apparatus has been firmly screwed to the latter. The dish, steel diaphragm, and the disc are covered by a dome, *a a*, in the centre of which moves the plunger, *d*; and on this cover, and under the foot of the rail, is a ring of solid india-rubber, *t*, laid round the plunger, *d*, to protect it from the penetrating sand, which otherwise might impede its free action. The pressure upon this steel diaphragm by the deflection of the rail, due to a passing train, forces some of the mercury in the dish underneath up the tube, *x*, and the cup, *y*, into which the



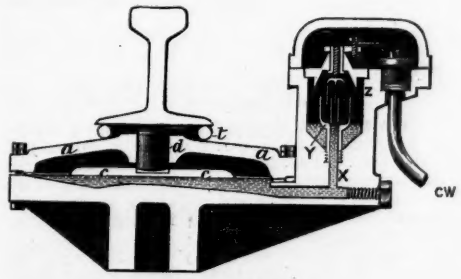
c w, Connecting wire.

Fig. 16.—Front.

contact points, *z* (to be joined together) are suspended, and thus closing the electrical circuit.

Nither of these forms have, however, been made use of on the Great Eastern Railway, but it would be interesting to learn from users of them to what extent they are in operation, and what is the result of their experience.

The form used on the Great Eastern Railway (and we have about 400 of them in use) is shown in fig. 18, and a model is on the table. This was designed by myself, in order to obtain a rubbing solid contact, in preference to mercury, and to be self-adjusting by the passage of each train.



c w, Connecting wire.

Fig. 17.—End Section.

It is secured to a strong timber, bolted to, and underneath, the ends of two adjoining sleepers.

As will be seen, it consists of an iron containing box, with a long heavy lever, 1, at one end of which is a tail-piece, 2, to fit into a corresponding hole in the web of the rail. A steel key-piece, 3, which is adjustable, is used to avoid undue looseness in the hole owing to wear and tear. At the other end of the lever, and insulated therefrom, is a self-adjusting friction clutch, 7, and contact piece, 4, which slides somewhat tightly up and down on the steel bar, 8; and the range of the movement of this is controlled by the steel stop pins, 5 and 6, without interfering with the free movement of the lever itself. It will be obvious that this arrangement provides that should there be a tendency to make contact through the road sinking the next train readjusts it, and, therefore, each train may be said to readjust the contact for the following train.

This friction clutch rail contact has given great satisfaction. During the six months ending September 30th last (probably our busiest months in the year), although the 400 rail contacts were operated in the aggregate for 5,856,000 trains, there were only five failures; and this, I think, is a remarkable result. During the months of July and August, however, though actuated in the aggregate for 1,953,000 trains, there was not a single failure.

Although it is exceedingly rare for a failure to take place on the wrong side (that is, the lock to be taken out before the train arrives), there is always the element of possibility that in any form of rail contact it may do so. In order to avoid this, I have devised a simple means for ordinary through rail contacts, which should practically extinguish this form of failure. At the spot where the rail contact is fixed, one of the rails is insulated at each end from the adjoining rail (see fig. 21), the usual metal fish-plates being insulated from the rails (or they may be replaced by oak blocks), and the positive pole of the rail contact battery, which is in a box on the spot, instead of

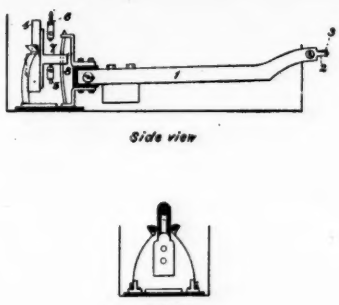
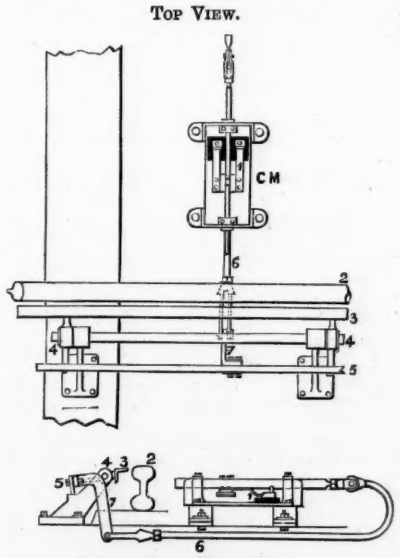


Fig. 18.

going direct to earth, is attached thereto. The battery is then only joined up to earth by the axle and wheels connecting the insulated rail to the opposite rail (which is making good earth), at the exact moment when it is wanted—that is, just as the wheels are passing over the rail, the deflection of which manipulates the rail contact. It should be remembered that with Sykes's locking the rail contact is not connected to the instrument at all, until the signal is taken off for the train.

The Electric Fouling Bar.

At certain points, after passing through a section, a train may not require to go into the section in advance; or it may be required to shunt into a siding to let a following train pass, and in this case it would not pass over the sectional rail contact.



c m, Contact maker.

Figs. 19 and 20.

To provide for this at the entrance of, but inside, the sidings, a Sykes's electric fouling bar (figs. 19 and 20) is fixed, of sufficient length to ensure that any vehicles entering shall always have at least one wheel on the bar to depress it. A few yards further in the sidings a rail contact is fixed. The depression of the bar, by actuating the switch, 1, breaks down the rail contact circuit, so that, although the latter is operated as the engine passes over it, it does not release the

back lock until the last vehicle has passed over the bar. This ensures the tail of the train being clear of the main line before a following train can be accepted.

In fig. 20 the rail is shown at 2, and the flange of each wheel depresses the bar, 3 (the axis of which is at 4), raising the heavy balanced end, 5, and pulling the rod, 6, connected thereto by the angle piece, 7, and actuating the switch, 1.

At very busy points it is sometimes desirable (in order to get the traffic through quickly), to allow more than one train in a block section, and this can be done with safety with Sykes's system. An advance starting signal is placed well ahead in the section, between two cabins, and is electrically controlled by the signalman ahead. A

Friction clutch rail contact piece on end of lever.

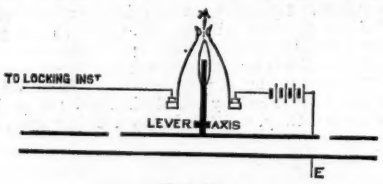


Fig. 21.

train, being accepted from the rear, may be passed out of that section, over a rail contact to release the starting signal back lock, up to the advance signal, and the starting signal put to danger behind it. Another train can then be accepted from the rear. The starting signal (apart from the mechanical locking), cannot again be pulled off, for the second train, until the advance signal has been lowered, and the first train passed over a rail contact, ahead of that signal, and the signal put to danger and relocked. Then the starting signal is free for the second train, and so on. We may, therefore, have a train between "A" and "B," another between "B" and his advance signal, and a third between that signal and cabin "C," all fully protected.

(To be continued.)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 322, *High Holborn, London, W.C., to whom all inquiries should be addressed.*]

25,360A. "Improvements relating to coating or covering of metals and other substances with metals and other materials by the aid of the electric arc." F. H. Snyder. Dated February 5th. (Date claimed under Patents Rule 19, November 11th, 1896.) (*Complete.*)

2,572. "Improvements in and connected with electric accumulator and battery plates." C. R. G. Smythe and M. Crawford. Dated February 1st.

2,578. "Improvements in the arrangements of field coils of shunt motors for use with storage or other batteries, and method of connecting such coils with the batteries." T. H. Parker. Dated February 1st.

2,582. "Improved means for use in operating successfully two or more electrical switches, or sets of switches." T. H. Parker. Dated February 1st.

2,592. "Electric fuses for mines." R. Linke. Dated February 1st. (*Complete.*)

2,619. "Improvements in electric current regulating and indicating appliances and instruments." W. Rowbotham. Dated February 1st.

2,622. "Improvements in the construction of arc lamps." H. Leitner. Dated February 1st.

2,643. "Improvements in electric lamps and electro-magnetic apparatus." W. E. Burnand. Dated February 1st.

2,701. "Improvements in electric propulsion." L. H. Nash. Dated February 2nd. (*Complete.*)

2,709. "Improvements in and relating to the electro-deposition of copper and other metals." W. E. Heys. (E. Demoulen, France.) Dated February 2nd.

2,710. "Improvements in the method of and apparatus for the electro-deposition of copper and other metals on rotary mandrels." W. E. Heys. (E. Demoulen, France.) Dated February 2nd.

2,711. "Improvements in and connected with apparatus employed in the electro-deposition of copper and other metals." W. E. Heys. (E. Demoulen, France.) Dated February 2nd.

2,712. "Improvements in and connected with apparatus for the electro-deposition of copper and other metals." W. E. Heys. (E. Demoulen, France.) Dated February 2nd.

2,721. "Improvements in and relating to electric motors." Theodore van Heemstede Obelt. Dated February 2nd.

2,737. "An electric alarm sash fastener." J. H. Morgan. Dated February 2nd.

2,758. "Improvements in electric meters." D. B. Carse. Dated February 2nd.

2,789. "Improvements in storage batteries." H. S. Lloyd. Dated February 2nd. (*Complete.*)

2,790. "Improvements in electric furnaces for use in the manufacture of calcium carbide applicable also for obtaining metals from their salts." L. Bresson and P. Pacotte. Dated February 2nd. [Date applied for under Patents, &c., 1883, Sec. 103, September 15th, 1896, being date of application in France.]

2,796. "Improvements in electric batteries." P. C. A. Laglenne. Dated February 2nd.

2,801. "Improvements in electrical transformers." A. F. Berry. Dated February 2nd.

2,818. "Improvements in electricity meters." S. Z. de Ferranti. Dated February 3rd.

2,873. "An apparatus for obtaining bi and multiphase alternating currents from a monophase current." W. Langdon-Davies. Dated February 3rd.

2,889. "Improvements in the globe or shade holders of gas, oil, and electric lamps." J. W. Lea and J. H. Perrins. Dated February 3rd.

2,964. "Improvements in perforators for use in connection with automatic telegraph transmitters." F. L. Muirhead. Dated February 3rd.

2,905. "Improvements relating to the transmission of signals through submarine telegraph cables." F. L. Muirhead. Dated February 3rd.

2,907. "Improvement in the construction of electric incandescent lamps." C. B. Miller. Dated February 3rd.

2,908. "Improvements in electric incandescent lamps." B. H. E. McCrea and W. J. Mitchell. Dated February 3rd.

2,935. "Improvements in switches for electric currents." W. R. Rawlings and J. J. Rawlings. Dated February 3rd.

2,940. "An automatic method of intermittently applying electric energy." B. H. Thwaite. Dated February 4th.

2,953. "Improvements in or connected with conduits for electric railways and tramways." W. Cope. Dated February 4th. (*Complete.*)

2,967. "Improvements in fittings for electric lamps." W. R. C. Wakley. Dated February 4th.

2,968. "Improvements in devices for wall plugs for controlling current for electric lighting, heating, or electric bells." F. C. Daffern. Dated February 4th.

2,995. "An improved battery applicable for electric lighting, telegraphy, telephones, and like." S. Heilman and S. Spiegel. Dated February 4th.

2,996. "Improved apparatus for automatically starting electric fire pumps and other electrical machinery." T. Rungay. Dated February 4th.

3,015. "Improvements in incandescent electric lamps or their connections or holders." A. E. Pope. (F. R. Pope, Holland.) Dated February 4th.

3,019. "Certain improvements in joint pieces for electrical conductors." E. Ivins. Dated February 4th. (*Complete.*)

3,044. "Improvements in the construction of spring jacks or switches used in connection with telephonic switchboards." D. Sinclair. Dated January 4th.

3,058. "Improvements in apparatus for propelling and regulating locomotives, motocars, carriages, cycles, applicable to steam, gas, electric, oil, or other mechanically propelled vehicles." H. F. Joel. Dated February 5th.

3,057. "New or improved magnetic and electric resistance shields." T. Holmes, G. S. Holmes and R. W. Stewart. Dated February 5th.

3,113. "Improvements in electrical accumulators." R. R. von Perks and J. Benger. Dated February 5th.

3,120. "Improvements in incandescent electric lamps or their connections or holders." W. P. Thompson. (F. R. Pope, Holland.) Dated February 5th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free*, 8½*d.* (*in stamps*).]

1896.

719. "Improvements in electrical accumulators or storage batteries." B. Willcox. (La Société L'Accumulator Fulmen.) Dated January 10th, 1896. Relates to an improved arrangement of electrical accumulators and consists of a compound casing of asbestos for holding the active material and protected by two perforated celluloid plates. The casings are retained in position by crosspieces secured to the celluloid plates. 4 claims.

5,703. "Improvements in arc lamps." A. J. Boult. (W. B. Jolles, E. H. A. H. Von Nellendorf.) Dated March 13th, 1896. Relates to a regulating mechanism, which does not require the tubular upper part as is usual in the more complicated mechanism. The carbon-holder to be adjusted serves by its weight to drive a simple stop mechanism, consisting of an escapement wheel and a pallet, the latter being operated by an electro-magnet which is placed in a shunt circuit. 4 claims.

9,528. "Improvements in telegraphic relays and the like." H. H. Lake. (E. G. Burke.) Dated May 5th, 1896. Relates to an improvements in cable relays which are required to be of great sensitiveness to current changes and which involve a coil of wire placed in a magnetic field, adapted by the passage through it of an electric current, to be moved or rotated in such field. The improvement consists in the more effective disposition of magnets or magnetic poles for producing the field or lines of force and in an improved form of coil. 4 claims.